N080-630 ERIC REPORT RESUME

ED 010 056 10-05-66 24 (REV)
A COMPARISON OF MATHEMATICS PROGRAMS FOR ABLE JUNIOR HIGH SCHOOL STUDENTS, VOLUME 1 - FINAL REPORT.
GOLDBERG, MIRIAM L. * AND OTHERS
DCW10517 COLUMBIA UNIV. H. MANN-LINCOLN INST. FOR SCH. EXP., NEW
BR-5-0381-VOL-1
-MAY-66
EDRS PRICE MF-$0.45 HC-$12.44 311P.

*MATHEMATICS INSTRUCTION, *MATHEMATICS CURRICULUM, *TEACHING METHODS, *JUNIOR HIGH SCHOOL, MATHEMATICS, MATHEMATICAL ENRICHMENT, COMPARATIVE ANALYSIS, LEARNING PROCESSES, LORGE-THORNDIKE VERBAL INTELLIGENCE TEST, NEW YORK CITY, NEW YORK, STEP READING TESTS, STEP MATHEMATICS TESTS

THE TALENTED YOUTH PROJECT (TYP) MATHEMATICS STUDY WAS DESIGNED AS A STUDY TO COMPARE THE EFFECTIVENESS OF VARIOUS CURRICULUM PATTERNS AND PRACTICES IN MATHEMATICS EDUCATION CURRENTLY USED WITH ACADEMICALLY TALENTED JUNIOR HIGH SCHOOL STUDENTS. THE SAMPLE CONSISTED OF 51 CLASSES AND 6 MATHEMATICS PROGRAMS. THE LORGE-THORNDIKE VERBAL INTELLIGENCE TEST, STEP READING TESTS, AND STEP MATHEMATICS TESTS WERE THE MEASURING INSTRUMENTS USED FOR THE SELECTION OF PUPILS IN THE SPECIAL PROGRESS PROGRAM. PUPIL-RELATED FACTORS SUCH AS INTERESTS, SOCIOECONOMIC STATUS, ATTITUDES, AND PUPIL SELF APPRAISALS WERE COLLECTED. THREE BASIC INSTRUCTION PROGRAMS WERE (1) A "STANDARD" CURRICULUM FOUND IN MOST COMMERCIAL TEXTBOOKS, (2) THE SCHOOL MATHEMATICS STUDY GROUP (SMSG) CURRICULUM PRINTED IN "MODEL TEXTBOOK" FORM, AND (3) UNITS FROM THE UNIVERSITY OF ILLINOIS COMMITEE ON SCHOOL MATHEMATICS (UICSM OR ILLINOIS) THAT WERE AVAILABLE TO SCHOOLS WHOSE TEACHERS HAD BEEN EXPOSED TO THE REQUIRED INSERVICE TRAINING. THE PROGRAMS SELECTED WERE PRESUMABLY DIFFERENTIATED ON TWO DIMENSIONS, CONTENT--STANDARD OR CONTEMPORARY--AND TEACHING-LEARNING PACE--ENRICHED OR ACCELERATED. END OF THE YEAR TEST RESULTS ARE GIVEN AT THE END OF GRADES SEVEN, EIGHT, AND NINE. ALTHOUGH ACCELERATION RESULTED IN GREATER ACHIEVEMENT THAN ENRICHMENT, AND THE CONTEMPORARY APPROACH APPEARED SUPERIOR TO THE STANDARD ONE, IT WAS IN THE COMBINATION OF ACCELERATION AND CONTEMPORARY CONTENT AND METHODOLOGY THAT THE GREATEST LEARNING OCCURRED, AT LEAST IN TERMS OF THE CRITERIA SET IN THIS STUDY. (GC)

A Comparison of Mathematics Programs for Able Junior High School Students

by Miriam L. Goldberg
A. Harry Passow
David S. Camm
Robert D. Neill

Volume I - Final Report

TALENTED YOUTH PROJECT
HORACE MANN–LINCOLN INSTITUTE OF SCHOOL EXPERIMENTATION
TEACHERS COLLEGE, COLUMBIA UNIVERSITY
NEW YORK, NEW YORK 10027

U. S. OFFICE OF EDUCATION
BUREAU OF RESEARCH
PROJECT NO. 5–0381

ACKNOWLEDGMENTS

A field research study of this kind is impossible without the cooperation of many persons. We are particularly grateful to the participating teachers, TYP Mathematic Study coordinators, and administrative officers of the following school systems and schools. [Those school systems marked with an asterisk (*) participated throughout the entire study.]

* Chappaqua, New York -- Robert E. Bell School and Horace Greeley High School.

* Cheltenham Township, Elkins Park, Pennsylvania-- Elkins Park Junior high School, Ogontz Junior High School, and Thomas Williams Junior High School.

* Clarkstown Central School, New City, New York -- Clarkstown Junior High School and Clarkstown Senior High School.

Closter, New Jersey -- Village School.

* Council Rock, Newtown, Bucks County, Pennsylvania -- Council Rock High School.

Farmingdale, New York -- Mill Lane Junior High School and Weldon E. Howitt Junior High School.

Greenwich, Connecticut -- Eastern Junior High School.

* Manhasset, New York -- Manhasset Memorial Junior High School.

* New York City, New York -- *Junior High School 117-Bronx, *Junior High School 73-Queens, Junior High School 158-Queens, *Junior High School 185-Queens, and *Junior High School 104-Manhattan.

* North Plainfield, New Jersey -- North Plainfield High School.

  Old Tappan, New Jersey -- Charles DeWolf School.

  Port Washington, New York -- Weber Junior High School.

* Ridgewood, New Jersey -- Benjamin Franklin Junior High School and George Washington Junior High Schhol.

* Scarsdale, New York -- Scarsdale Junior High Schhol and Scarsdale High School.

* Suffern, New York -- Suffern High School.

* Summit, New Jersey -- Summit Junior High School.

* Teaneck, New Jersey -- Benjamin Franklin Junior High School and Thomas Jefferson Junior High School.

  West Caldwell, New Jersey -- West Essex Regional High School.

* Westwood, New Jersey -- Westwood Junior High School.

* Woodmere-Hewlett, New York -- Woodmere Junior High School-North and Woodmere Junior High School-South.

We wish to express our special gratitude to the following consultants who conducted the in-service education of the teachers, assisted with the construction of the Teacher-Made Tests and were of continuing help in the study:

Arnold Peterson-- Chairman, Mathematics Department, the Pascack Valley (New Jersey) Regional High School. Harry Ruderman-- Chairman, Mathematics Department, Hunter College (New York City) High School. Leonard Simon-- Curriculum Consultant in Mathematics, Bureau of Curriculum Research, New York City Public Schools.

We wish to thank Dr. Sheldon Myers and Mrs. Miriam Epstein of Educational Testing Services, Princeton, New Jersey, for the preparation

of the six ETS tests used in this study.

A major contribution to the study was made by the following research assistants who participated at various times during the course of the project:

David Camm, John P. Downes, George Gunning, Sam Hamburger, Aida Keshishian, Robert D. Neill, and Michael Rothenberg.

We are especially grateful to Miss Keshishian and Mr. Camm for their assistance in the preparation of the final report, including the data processing and analyses.

The task of typing the final report and its many tables was accomplished by the following persons. We express our sincerest thanks to:

Eleanore Ellsworth and Donato Capozzoli

Typing of tests and handling of other secretarial duties during the course of the study were done by Miss Ellsworth, Mr. Capozzoli, Mrs. Elaine de Leon and Miss Myrna Rosen.

This demonstration-research project represented a cooperative study in many senses. Schools not only provided populations for testing, but were actively engaged in the teaching programs and in preparation of the Teacher-Made Tests. We are deeply appreciative of their efforts and hope that the findings reported herein will be of use to them in the further development of their own mathematics programs.

Miriam L. Goldberg

A. Harry Passow

Teachers College
Columbia University
New York, New York

May 1966

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CHAPTER I

Background of the Study

Mathematics teachers and school administrators are perplexed by the choices available to them in the area of mathematics for the academically talented. The availability of a number of alternative programs, with no reliable information as to their value for the talented population, led to the design of a demonstration-research project to provide guidelines for content and procedural selection in junior high school mathematics.

This project emerged from a study conducted by the Talented Youth Project of the Horace Mann-Lincoln Institute of School Experimentation in cooperation with the Cheltenham Township (Pennsylvania) Public Schools. That study involved an assessment of the effects of varied instructional procedures and content on the mathematical achievement and attitudes towards mathematics of academically able junior high school students. In Fall, 1957, incoming seventh graders were selected for four comparable classes. Students were individually matched on intelligence, reading and arithmetic achievement, teacher assessment, chronological age and sex. For the four groups, the average I.Q. was 132-133; mean reading scores, 9.4-9.8; mean arithmetic achievement, 9.2-9.3; and teacher ratings, good-excellent. All four classes were pre-tested on a series of attitude and achievement measures.

During the first year, one of the Cheltenham classes was accelerated through a traditional arithmetic program, and, by the end of the year, demonstrated its readiness for the study of algebra by scores on standardized arithmetic tests and on a prognostic test in algebra. Two of the groups followed the prescribed seventh-grade material but spent time on a series of "enrichment" units covering the History of Numbers, Number Systems, Powers and Their Meaning. The fourth group served as a control. The following year, the Accelerated class completed the first year algebra and began the second algebra course. One of the Enrichment groups completed eighth-grade arithmetic and continued work on additional units dealing with Measurement and Statistics, Operation of Computers, Logic and Topology. The second enrichment group shifted to the University of Illinois Committee on School Mathematics (Illinois) program and completed Units I and II and began Unit III. The fourth group continued as a Control, following a standard eighth-grade mathematics program. In the ninth-grade, the Accelerated group completed the second year algebra course; the Illinois class completed Units III, IV and V. The Enriched class had a standard first-year algebra course with the addition of units titled Laws of Arithmetic, Logic, and Concepts of Inequality and Equations. Again, the Control class had the first-year algebra course commonly taught to students. The senior high programs were later modified to provide articulation with the junior high school experimental work.

At the end of the junior high three-year period (May 1960), the STEP Mathematics Test, Form I-A, was administered to all four classes. The publisher's college freshman norms were used in assessing percentile ranks. In addition, a 24-item teacher made test, consisting of 6 items from each of the four approaches or programs was administered. On the STEP test, the Accelerated class scored significantly higher than the Enriched and Control classes (at or beyond the .05 level of confidence). Differences between the Accelerated and the Illinois classes on this test were not statistically significant. The Illinois class scored significantly higher than the Control class but did not do significantly better than the Enriched class. The Enriched group's mean score appeared somewhat higher than that of the Control class, but the difference was not statistically significant. On the teacher-made test, the Accelerated class scored significantly higher than did either the Enriched or the Control groups (beyond the .05 level of confidence). The Illinois group scored significantly higher than the Control class. Neither the difference between the Enriched and the Control classes, nor the differences between the Accelerated and the Illinois classes, was significant.

The attitude inventory used at the beginning of the seventh grade was revised and readministered. The items on this inventory dealt with such topics as: Mathematics Impact on Society, Characteristics of the Mathematician, Mathematics as a Career, The Nature of Mathematics, Self-Appraisal of Mathematical Ability and The School's Effectiveness in Teaching Mathematics. The four groups differed significantly on the number of "positive" or "correct" responses given in some of the categories, but not in others. For most of the six categories, the order of the scores were similar to the pattern observed in the achievement test -- Accelerated and Illinois groups higher than the other two.

At the conclusion of the three-year Cheltenham study, the data indicated that acceleration and enrichment were not "opposing" concepts. On the contrary, acceleration, either through the standard curriculum or through newly developed curricula, seemed to provide talented students with meaningful and enriching experiences. Enrichment, on the other hand, seemed to become meaningful only when the students dealt with more advanced and more difficult concepts.

The Cheltenham Study involved only four classes with a single teacher for each of the programs. The findings raised many interesting questions which could not be answered due to the design restrictions. There were some differential outcomes in pupil achievement and attitude, but these might have been related to the mathematics program followed, to teacher variables, or to other causes. The study demonstrated the need for doing something "extra" in mathematics for academically talented junior high school students, but it tended to be hypothesis-generating more than it did to provide clear directions for mathematics teachers and administrators. A partial replication which was initiated a year after the first one started, yielded essentially the same findings. A grant from the United States Office of Education Cooperative Research Program, together with continued support from the Horace Mann-Lincoln Institute of School Experimentation, made possible a demonstration-research undertaking to assess the relative effectiveness of varied approaches to the teashing of mathematics to academically talented students with a number of classes for each program.

Related Research and Review of the Literature

The out-pouring of mathematics curriculum materials during the 1950's elicited two kinds of responses: one, "wait-and-see" and the other, "any-change-is-a-good-one." Some educators sought "convincing" evidence before making changes in their schools. Others made changes and looked for support for their choice. Both approaches indicate a need for studies regarding the appropriateness of suggested curriculum revisions (whether based on contemporary mathematical thought or rearrangement of traditional content), as comparisons between and among programs are few. This is especially true with respect to programs for the academically talented.

A thorough search of the literature dealing with mathematics education and the academically talent... preceded the initiation of the Cheltenham Study. Much of the literature is exhortative without serious analysis of the factors involved in making adequate provisions for the talented. Some consists of surveys of programs and "promising practices." The body of research and experimentation is not extensive.

<u>Surveys of Programs and Provisions</u>

McWilliams and Brown (1957) described the provisions for mathematics education for superior junior high school pupils made in some 80 schools visited by the senior author. Class and out-of-class activities, special classes, acceleration, and resource materials were described as illustrative of provisions found. The findings from extensive surveys of provisions for teaching rapid learners in junior, senior and four-year high schools were reported by Jewett and Hull (1954) and by Frain (1956). The former surveyed public schools; the latter, Catholic schools. Multitrack programs and individualized instruction were described as the most widely used practices but no evaluation was made of the effectiveness of any of the administrative or instructional modifications included in either publication.

Bryan (1960) prepared a questionnaire to which 124 seventh and eighth grade teachers of mathematics responded. From an analysis of the responses and a study of the professional literature, Bryan suggested an accelerated mathematics program for gifted students which centered around concepts of number, symbolism, measurement and approximation, statistics and functions. She proposed their completing the first half of the ninth year by the end of the eighth grade. Roach (1958) studied the mathematics and science programs for gifted Indiana secondary school students and found that 95 per cent of the 91 schools which responded to his questionnaire used enrichment as the chief method of providing for gifted students. Sixty-seven per cent of the schools practiced homogeneous grouping in mathematics for the gifted.

Other surveys focusing specifically on mathematics programs for the gifted have been reported by Baumgartner (1953), Brinkmann (1954), and Gordon (1955). The National Council of Teachers of Mathematics (Cance, 1955) and the National Education Association's Project in Academically Talented Students (Hlavaty, 1959) both issued detailed reports on program provisions for mathematics for the gifted. Both pamphlets contained descriptions of existing courses and proposals for improvement of programs but included no experimental findings. Blank (1964) reported a survey concerning content of advanced mathematics curricula.

Enrichment and Acceleration in Mathematics for Talented Junior High School Students

Curriculum developers suggest two learning "paces" for talented junior high school students -- acceleration or normal progress with enrichment. Usually enrichment is considered an addition to the normal program of studies, a broadening and deepening of learning experiences. Acceleration, on the other hand, connotes the movement of students through a program of studies at earlier years or in less time than average students take. In practice, enrichment in mathematics usually means additional problems, reports, or reading; while acceleration may mean algebra in the eighth grade or an advanced course at the senior class level. Both approaches are widely used with talented junior high school students.

A few studies have reported the results of experiments in which gifted students have been in enriched programs. Lessinger and Seagoe (1956) designed, tested and evaluated an enriched geometry program for gifted students. Six enrichment units were developed and taught to an experimental group of able youngsters in addition to the regular course. The same teacher taught the regular geometry course without the enrichment units to a control group. The experimental class showed a better grasp of the subject matter, acquired greater understanding of mathematics in general, were able to apply mathematics principles and insights better, showed more originality and creativity. However, the experimental group did not do better than the control in assimilating new mathematics materials.

An enrichment program in four classes of 98 selected students was studied by Long (1958). In two classes, the talented pupils served as group leaders, gave special reports and projects, and presented new topics and materials. In all four classes, the same teacher taught the same topics and gave the same assignments and tests. In the two experimental classes which had the enriched program, both the talented and nontalented group surpassed the control groups in both achievement and attitude. Dorris (1963) used a specially planned program of traditional mathematics plus units from contemporary mathematics and found the program better suited for high ability groups than lower.

Elder (1957) and Devine (1960) described seminars as a means of enriching mathematics for gifted students at the junior and senior high schools. Alternative courses for a twelfth-grade mathematics program for able girls were developed and tested by Lawton (1960). A course in mathematical analysis seemed most desirable on criteria developed by Lawton who incorporated seminar work and individual projects into the program.

After two years of experience with seventh graders in central New York state schools Davis (1960) concluded that seventh graders seemed able to learn algebra. The results of an informal study were reported by Wells (1958) in which the achievement of capable students in an eighth-grade algebra class was compared with that of ninth-grade students taking a similar course. The able students achieved as well or better than the ninth-grade control class.

Culbertson, (1961) studying an accelerated program in algebra, science, reading and vocabulary, reported that groups covering a three-year program of studies in two years were as successful in algebra and reading but somewhat less successful in science and vocabulary as non-accelerated students. In general, achievement scores favored acceleration. Lang (1962) assessed pupil achievement and pupil, parent, teacher and administrator attitudes in accelerated and non-accelerated classes in a three-year study and found that all measures favored an accelerated mathematics program. However, a 40% attrition of students over the three years pointed up problems of initial identification and selection for accelerated programs. Strand (1962) studied the effects of supplemental instruction (15 minutes, twice per week for six weeks) in the form of units on sets, number bases, and comparison of addition in four different numeration systems. He found that the experimental group (26 eighth graders) compared favorably with the control class (15 eighth graders) who spent equal time on traditional mathematics.

In a study involving 66 eighth-graders and 62 ninth-graders enrolled in a beginning algebra course, Lawson (1961) found that the eighth-graders achieved significantly higher scores than did the ninth-grade pupils. All pupils were academically able. The classes were divided in two on the basis of I.Q., arithmetic achievement, and teacher recommendation. There were no significant differences in achievement gains between the upper and lower ability groups.

From a longitudinal study of the effects of acceleration and enrichment programs on attitudes of pupils in eighth grade mathematics and ninth grade algebra, Ray (1961) reported that the attitudes of accelerated students were more positive than those of students who had participated in enriched courses. Passow, Goldberg, and Link (1961) reported at the end of a three-year experimental program for gifted junior high school pupils, attitudes toward mathematics in general and toward the pupil's own mathematical ability increased more in the accelerated classes (whether traditional or contemporary) than in classes which followed a non-accelerated traditional curriculum or even a program "enriched" by the addition of various units from contemporary mathematics.

Mathematics for the Talented Student

Writers sometimes cause confusion by speaking of mathematics programs for the academically talented student in the same terms as they do about programs for the mathematically talented student. "Academically talented" students include all those who will eventually specialize in the arts, sciences, business, the various professions, as well as in technology. "Mathematically talented" students are those academically talented students whose greatest proficiency lies in mathematics.

The age at which successful mathematicians become engaged in mathematics varies, but the majority seem to have made their choice early. Lloyd (1953) referring to a Swiss survey of 93 mathematicaians, relates that all 93 had been committed to their life's work by the age of 26, all but four of them by the age of 18, and the vast majority before the age of 15, the age at which students leave American junior high schools. Little attention is given in the literature in formulating an operational definition of "mathematically talented." There appears to be a high, positive relationship between reading ability and success in mathematics courses. Such success is, of course, also related to IQ or general intellectual ability. Certain special qualitites, such as those listed by Fehr (1954) -- high level abstract thinking, intellectual curiosity, persistent goal-directed behavior, virtuosity in mathematics often gained through individual study -- are often exhibited by successful mathematics students. While Guilford (1961) has identified specific components of intelligence which are essential for creative work in mathematics, these components apparently enter into creative efforts in other areas of knowledge as well. The identification of the potentially outstanding mathematics student is based on limited information.

Most programs in mathematics for talented students rely heavily upon identification procedures based on intelligence, reading, mathematical aptitude, socio-economic status, teacher appraisal, and pupil interest. In his study of high school seniors, Jordan (1964) found that between 38.9% and 62.4% of the criterion variance could be explained by IQ and socio-economic status. Hegstrom (1963) reported that another 16% of the criterion variance may be accounted for by other variables used in selection such as teacher appraisal, past achievement, pupil interest and mathematical aptitude. Perhaps the restricted range of intelligence, the selection tests, and the evaluative criteria used by Hegstrom account for the small amount of variance he obtained. Fitzgerald (1963) concluded, after studying fifth, seventh, and ninth grade mathematics students, that "the ability of a child to learn mathematics is a unique characteristic of the child just as are height, reading skill, and chronological age." At the present time there is no simple measure or combination of measures which will allow wholly reliable prediction of mathematical ability.

In the absence of specific guides, what to teach academically talented students after identifying them is still a difficult decision. Johnson (1953) suggested that the most practical and the easiest thing for schools to do for academically talented students in mathematics is to make differentiated assignments. Assignment differentiation may involve additional study, research opportunities or accelerated coverage. Hartung (1953) points out that we have no evidence that what bright students are taught is "the best for them at their level of advancement, nor that other students of lower ability could succeed with the same sort of work."

There are many questions concerning the appropriateness of the various current mathematics programs for academically talented students. Klausmeier (1959) found that 1) retention of material learned is the same for low, high, and average ability groups if the mathematical tasks are put at the learner's achievement level; 2) the within-pupil variance in achievement is the same for all ability groups; and 3) curriculum programs are typically oriented to average intellectual groups. Identification of talented students would enhance the efficiency of acquiring mathematical knowledge by "at least one grade level and possibly two for high IQ children by the end of the fifth grade."

A variety of practices designed to meet the needs of academically talented junior high school youngsters are found in the literature. Rudnick (1962) found that most provide for algebra in grade eight instead of grade nine, with analytics and calculus or statistics taking the place of former senior class offerings. Many studies show that algebra in the eighth grade is both possible and practical. Rosskopf (1958, 1961) does not agree with this type of provision for academically talented students, maintaining that an emphasis on mathematical structure, precision of language, work with concepts of equality and inequality, and the nature of proof are more appropriate learning experiences than traditional algebra.

Investigators have explored the possibility of using Joplin-type plans where ability groups, regardless of chronological age receive instruction together (Davis and Tracy, 1963); television instruction (Rollins _et al_, 1963); grouping procedures (Keaveny, 1959; Cawelti, 1962); and self-instruction designed to provide enrichment, (Payne 1958). Either no evaluation or inconclusive evidence has been presented in testing the merits of the various suggestions.

Attitudinal changes have been investigated by Lyda and Morse (1963) and by Ellingson (1962). Both studies show that change in attitudes toward mathematics correlate with achievement and method of instruction. Ellingson reported that attitude scores were better predictors of performance in mathematics in high school as measured by the Iowa Tests of Educational Development than teacher judgment or initial scores from a similar battery of Iowa Tests administered in the sixth grade.

In studies of various grouping patterns, i.e. homogeneously grouped *versus* heterogeneously grouped classes, Mahler (1961), Mulhern (1960) and Becker (1963) found no differences in mathematical achievement, but none of the investigators noted differentiation in subject-matter content offered students in the various grouping patterns. As in other studies, grouping pattern has little effect on the achievement of academically talented youth unless accompanied by differentiation in content or pace or materials.

Proposals of a more or less specific nature for improving mathematics programs for talented students have been advanced by Ahrendt (1953), Fehr (1959), Glennon (1957), Hartung (1953), Keaveny (1959), Lapino (1956), Lloyd (1953) and Rees (1953).

Specific Efforts to Provide for the Mathematically Talented: Local Programs, Summer Institutes and Seminars

Two additional types of provisions provide mathematically talented junior and senior high school youth with experiences beyond those found in the regular school program. One consists of extra classes outside or after school, Saturday or evening seminars. These are generally supported locally. The other consists of summer institutes held on college and university campuses, often encouraged and supported through funds from the National Science Foundation, private corporations, or foundations. In selecting students for such programs preference is usually given to those who are finishing the eleventh and twelfth grade. This criterion for selection stems in part from the fact that college personnel employed to teach the courses may be more comfortable with an age group akin to regular college students. The usual curricula offerings include set theory, analysis, symbolic logic, computer mathematics, and mathematical research. In both types of programs guest lecturers are used.

Relatively few institutions and seminars include junior high school students. Assumption Preparatory School, Worcester, Massachusetts (Van der Linden, 1962) and Rollins College, Winter Park, Florida (Wavell, 1962) are two schools which accept thirteen year old students. During the summers of 1962-4, Teachers College, Columbia University conducted a special summer program for highly gifted pupils who had completed the sixth grade. A portion of the program each summer was devoted to work in advanced mathematics.

Two programs open to talented junior high school students were found at Iowa Teachers College Laboratory School (Nielson, 1959) and at Illinois Normal State University (Flagg, 1961). The Iowa summer institute for bright ninth graders offered instruction in set theory, relations and functions, analysis of the plane, logarithms and slide rule, linear programming, probability and statistics. Illinois Normal made provisions through the academic year as well as in the summer months for bright junior high school students.

Most school programs emphasize acceleration of students into algebra at the eighth grade level, and this pattern remains the predominant one in curriculum design. When Baker (1962) surveyed the Michigan school systems to determine which kinds of provisions were being made for the mathematically talented youngsters of junior high school age, only 18% of the schools reported any special provisions at all. However, the 18% of schools which reported special programs enroll approximately one-third of the State's school population. Thus, at best, only about one-third of those who might be eligible have a chance to participate. Both enrichment and acceleration are practiced in the Michigan schools, with acceleration into algebra in grade eight the more common procedure.

Studies Involving Contemporary Mathematics Programs

Few studies have been reported which contrast contemporary with traditional programs. One study compared UICSM with SMSG; three studies contrasted achievement in UICSM classes with that made in traditional classes; a few have compared SMSG programs with traditional programs. Several SMSG studies were reported from evaluations at the Minnesota National Laboratory.

In a study of seventh and eighth grade students who attended SMSG classes for two years, Ziebarth (1963) found no difference between mean achievement of SMSG students and that of comparable students who followed traditional programs, as measured by the "Quantitative Thinking Test" of the Iowa Tests of Educational Development. However, significant differences in favor of the traditional program were obtained on the "Fundamental Operations Test" of the Iowa Every-Pupil Test of Basic Skills. Kraft (1962) evaluated the achievements of 92 classes, grades 9-12, using SMSG materials. On test-retest forms of STEP Mathematics the SMSG students did as well or better than did students nationwide.

No differences in student achievement were found by Shuff(1962) who compared pupils who had one year of SMSG with pupils who followed a traditional program. Using scores from STEP-Mathematics and COOP-Mathematics tests, he also reported finding no sex differences in achievement and no differences in pupil achievement attributable to teacher training, including attendance at summer institutes. In matched classes using SMSG materials, some of which had self-selection activities one or two days per week and others which had no such self-selection activities, Ebeid (1964) found no differences in achievement between the two groups although he did note improved attitudes in the experimental classes (self-selection activities) compared with those of the control classes.

In a study involving 623 pupils in grades five and eight comparing SMSG and traditional classes, Phelps (1963) found differences on the Dutton Attitude Scale. Fifth-grade SMSG pupils had better attitudes than their "traditional counterparts; similar differences were not found at the eighth grade. SMSG program demands for rigor and precision of language apparently did not have a negative effect on attitudes toward mathematics. Phelps also found a positive relationship between SMSG students' achievement scores and scores on measures of ability to think "creatively." In fact, he found that SMSG students at both grade levels scored significantly higher than traditional students on a Uses for Things Test (an instrument which calls for naming as many uses of two common objects as one can in three minutes). According to Phelps, students with higher IQ's tended to make higher scores on the "uses" or creativity sub-test.

In a comparison of SMSG and traditional classes from grade seven through ten, Williams and Shuff (1963) found that when intelligence was held constant, significant (.05 level) achievement differences on STEP tests favored the SMSG classes in the tenth grade only. For the eighth grade, scores tended to favor the traditional students.

Pate (1964) compared transactional patterns in SMSG and traditional classes. SMSG teachers used a higher proportion of divergent questions, spent more time elaborating on lessons, and had more interaction with pupils than did traditional teachers. Traditional teachers used more cognitive-memory operations. However, even though there was greater rigidity in the traditional classes, sufficient freedom existed to allow for pupil-pupil interaction.

Nelson (1962) studied the effects of varied textbook presentations on the mathematics achievement of high ability junior high school students (285 seventh and 460 ninth graders) in 14 schools. One experimental class of each pair used the SMSG R text (for college-capable) and the other used the SMSG M text (same topics but simplified for slower learners). He found that except for the very highest achievers, the M texts tended to facilitate learning of mathematics for all high-ability students.

In seeking evidence concerning SMSG student performance on Educational Testing Services tests of traditional mathematical skills, Payette (1961) studied samples of seventh, ninth, tenth, eleventh and twelfth grade pupils both in SMSG and in traditional classes. On the basis of various analyses performed, he found that: 1) "students exposed to conventional mathematics have neither a pronounced nor a consistent advantage over students exposed to SMSG mathematics with respect to the learning of traditional mathematical skill;" 2) with respect to developed mathematical ability beyond that developed in traditional programs, "SMSG showed consistent extensions of developed mathematical ability;" and 3) that students at all levels of aptitude "can learn considerable segments of SMSG materials."

Rosenblum (1961) evaluating achievement in SMSG classes at the Minnesota National Laboratory, found that with ability level held constant, SMSG students did as well as other students. In seventh grade evaluations, SMSG pupils in seven of thirteen classes scored significantly higher on post-tests than their peers in traditional programs. Four other SMSG classes scored higher, but not significantly higher, than their control classes. The two control classes with higher means than their SMSG counterparts were not statistically different from the means of the two SMSG classes. However, differences in scores on retention tests between SMSG and "traditional" pupils were not significant, although SMSG mean class scores still remained higher. Comparisons done at the Minnesota National Laboratory in grades other than seventh grade were inconclusive, although SMSG student performance generally was higher than traditional student performance.

When the achievement scores of the top 20% of seventh grade students in SMSG and non-SMSG classes were compared by Mikkelson (1961) no differences were found between the groups in achievement as measured by both STEP and California Arithmetic Reasoning and Arithmetic Fundamental tests.

Loman (1961) studied the effectiveness of UICSM algebra and traditional algebra curricula with two middle-track ninth-grade classes of a three-track program. A statistically significant difference in favor of the UICSM group was obtained in the upper one-third ability level on the tests of understanding of basic mathematical concepts. No real differences were found at the middle or lower-third of intellignece. Nor were there any apparent differences in achievement of mathematical ability at any level of intelligence.

In comparing the achievement of approximately 1700 superior pupils in UICSM first year algebra classes with 700 pupils in "traditional" first year algebra classes, Tatsuoka and Easley (1963) found that pupils in both UICSM eighth- and ninth-grade classes performed significantly better on Cooperative Algebra Test (Elementary), Forms T, X, and Y. These tests measure traditional mathematical content. Since pupil aptitude was not the same for all groups in the study, an analysis of covariance was performed which equated all pupils' scholastic ability as measured by Differential Aptitude - Verbal Reasoning and Differential Aptitude - Numerical Ability. Both UICSM groups performed significantly better than non-UICSM pupils. When Tatsuoka and Easley compared eighth grade mean achievement with ninth grade means, they found eighth grade pupils did significantly better than ninth grade pupils, where both groups had studied UICSM materials. After removing the higher-scoring eighth grade sample, the ninth grade UICSM scores were still significantly higher than ninth grade traditional scores. The investigators concluded that UICSM material was adequate in preparing superior students to cope not only with UICSM tests but also with conventional tests.

In another UICSM investigation Tatsuoka and Comley (1964), using a matched-pairs design, compared the achievement of UICSM first year algebra students with non-UICSM first year algebra students in the Inglewood, California schools. The Cooperative Elementary Algebra Test and the Cooperative Algebra I Test were used to assess "superior" pupil achievement in both eighth- and ninth-grade algebra classes in the study. Pupil-related variable considered in the covariate analysis of the two criterion scores were pupil assessments on SCAT-Verbal, SCAT-Quantitative, California Algebra Aptitude Test, STEP-Mathematics, and pupil sex. Teacher ratings made by a teacher's principal were also included in the analysis. Although UICSM student means were higher than those of the controls, the adjusted means which took into consideration all variables used in the analysis, were not significantly different. However, when the teacher rating score was excluded from the analysis, the UICSM means were significantly higher than the control group means. Tatsuoka and Comley suggested that the superior performance of UICSM pupils may be due to superior teachers.

In Conclusion

From the number of reports issuing from school systems, it is evident that more and more effort is being made to provide for able students in mathematics. The questions of what should be the nature of mathematics for the talented and what kind of special provisions should be made have not been adequately explored experimentally at any educational level. What research has been done is quite limited, often testing one modification against a traditional program for a brief time. The Cheltenham Study compared several approaches over a three-year period. However, only one teacher and one class followed each pattern. This present study field tested larger numbers of students and teachers with more varied approaches to the mathematics programs for talented junior high school pupils.

Purpose of the Study

The two purposes of this demonstration-research study were:

1. To assess differential outcomes of various approaches to teaching mathematics to academically talented junior high schools.

2. To develop guidelines for content and procedural selection in junior high school mathematics.

CHAPTER II

Design of the Study

The Talented Youth Project (TYP) Mathematics Study was designed as a four-year, nine-months study to compare the effectiveness of various curriculum patterns and practices in mathematics education currently used with academically talented students in junior high schools. From the many programs available in 1961, only a few of the most widely used and apparently intrinsically different were included. The study did not purport to assess all mathematics programs available to school systems.

Initiation of the Study

In September 1961, more than 100 questionnaires asking for information about classes, school organization and mathematics programs were sent to all members of the Metropolitan School Study Council, to other selected schools in the metropolitan New York area and to two systems in the Philadelphia area which had indicated interest in or had reported special provisions in mathematics for academically talented students at the junior high school level.

The questionnaire asked for information about (1) the number of incoming seventh graders for 1962-63 who might meet the criteria of IQ 120 or higher and two or more years acceleration in reading and mathematics achievement; (2) the kinds of mathematics programs presently used (including UICSM, SMSG, algebra in the eighth grade, etc.); (3) the number of teachers trained for special mathematics programs (including summer institutes); present provisions for inservice training; and (4) interest in exploring further the possibilities for cooperating in the study. A letter describing the project accompanied the questionnaire.

Those school systems which indicated an interest were invited to a meeting to discuss the project. Twenty-eight school systems sent one or more representatives to a meeting at which the project was explained in detail, the alternative kinds of programs presented and the requirements for participation made clear. Each school system which expressed willingness to participate was asked to make a firm commitment to keep classes intact, as far as possible, for the full three years and to keep these classes in the same curriculum pattern or course of study for the duration of the study. The school representatives were asked to indicate the kind of mathematics classes they would be willing to organize for September 1962 and to discuss this with the school administrators. In some instances, the investigators visited schools to discuss cooperation with staff and administrators. By July 1962, 20 school systems had committed themselves to furnish at least 43 classes. This number was increased by the fall to a total of 25 school systems, 35 schools, and 51 classes.

The Program Variables

Three basic programs of instruction were selected: 1) a "standard" curriculum found in most commercial textbooks, 2) the School Mathematics Study Group (SMSG) curriculum printed in "model textbook" form, and 3) units from the University of Illinois Committee on School Mathematics (UICSM or Illinois) which were available to schools whose teachers had been exposed to the required in-service training. Adequate materials were available in all three of these basic curricula for students to pursue during the subsequent years of high school; all three basic programs were adaptable to modification for gifted population by acceleration or by enrichment. Each of the three programs was distinguishable either by its inherent content, the age of students at whom the content was aimed, or the teaching methodology implicitly or explicitly involved. For example, UICSM's First Course, intended for average ninth grade students, encourages as the teaching method a type of discovery called "non-verbal awareness." To a lesser degree, this approach is present in the SMSG materials and is absent from most commercial textbooks written before 1957.

The program variables are presented in Table 2-1.

Table 2-1

Program Variables in the TYP Mathematics Study

Content	Teacher-Learning Paces: Enriched	Teacher-Learning Paces: Accelerated
Standard	Standard-Enriched	Standard-Accelerated
Contemporary	SMSG-Normal	SMSG-Accelerated UICSM-8 UICSM-7

The programs selected were presumably differentiated on two dimensions: content -- standard or contemporary -- and by teaching-learning pace--enriched or accelerated. Thus, each cell in the design could be identified by both the content and the teaching-learning pace used.

The terms in Table 2-1 are used as follows:

Standard - refers to programs which utilize mathematical content found in textbooks prior to 1957, characterized by an emphasis on arithmetic processes and social application problems in Grades 7 and 8 and a course in elementary algebra taught by the demonstrative method at Grade 9.

Contemporary - applies to course materials developed by special committees or commissions since 1952 for the purpose of updating mathematical content and improving teaching methodology. These are programs usually referred to as "new" mathematics.

Normal - refers to a teaching-learning pace which limits presentation of material designed for a grade level to that grade level. For example, in seventh grade no eighth or ninth grade material would be included for any student. However, it allows for the addition of material outside the standard sequence or more intensive study of some aspects of the material.

Accelerated - refers to a teaching-learning pace which allows for either 1) moving through a given sequence in less time than usual, e.g., completing two years' work in one year or 2) beginning a given sequence at a grade level lower than the one for which the material was intended, e.g. starting algebra in grade seven or eight instead of grade nine.

Enrichment - refers either to content outside the regular sequence added to the standard textbook work, as in the Standard Enriched Program, or to depth study of particular aspects of the standard sequence, as in the SMSG-Normal Program.

Description of the Programs

a. Standard-Enriched Program -- In the first two years, these classes followed the content found in most commercial textbooks for seventh and eighth grade arithmetic, respectively, and in grade nine, went on to first-year algebra. The courses were "enriched" by the addition of four units in seventh grade, four in eighth, and three in ninth. The nature of the enrichment units can be illustrated by the four taught in the seventh grade:

Unit I. The Beginning of Numbers -- an historical overview of man's development of systems for counting; number systems whose base is other than ten; games such as "Nim" or making "nomographs" for calculating in base five and base two, to develop concepts of numeration system structure.

Unit II. Introduction to Mathematical Structure -- commutative, associative and distributive properties of numbers using addition and multiplication operations; identity elements for addition and multiplication; proofs of number statements using the basic principles of number operations as axioms; modular arithmetic; the property of closure.

Unit III. Exploration and Instruction -- prime and composite numbers; divisibility rules for 2, 3, 4, 5, 9 and 10; factorization - greatest common divisor and least common multiple.

Unit IV. Mensuration -- number intervals and significant numbers; rounding, rounding errors and relative errors.

b. Standard-Accelerated Program -- In the first year these classes completed the standard seventh and eighth grade content, omitting eighth grade material which duplicated or reviewed seventh grade topics. This allowed teachers time to present "directed" or signed numbers and their four mathematical operations (addition, subtraction, multiplication and division), as well as the solution of linear equations with one and two unknowns. All content was derived from standard, commercial textbooks and no "enrichment" units were added. All of these classes completed the first year of algebra in the eighth grade. At this point, problems in articulation with the high school program resulted in some of the classes continuing into plane geometry and one class into second-year algebra (as originally intended). A number of classes were forced to withdraw from the study entirely.

c. SMSG-Normal -- These classes followed the SMSG materials as presented in the available texts, proceeding at the pace intended by the authors. This program emphasizes a "spiraling" technique of presentation of its content rather than a particular methodology of teaching. Seventh and eighth grade SMSG materials contain elements of the entire junior and senior high school sequence; the role of definition, abstract conetps, precision in vocabulary, and experimentation in mathematical thought. Thus, the content for grades seven and eight contains a sound, intuitive basis for later algebra and geometry courses. SMSG content for the junior high school years parallels the material related to the properties and principles of numeration systems in UICSM Units I, II and III. However, SMSG extends its coverage of numeration systems beyond the systems of real numbers and their isomorphic relation to arithmetic numbers. Through a study of systems whose bases are other than ten, the natural or counting numbers, the rational numbers, and modular arithmetic, students observe, the students observe, generalize, and use the principles and properties of the real numbers. In addition, and more extensively than UICSM, SMSG texts present topics in metric and non-metric geometry.

d. SMSG-Accelerated -- These classes were accelerated through the standard SMSG Program. In the course of the three junior high school years, the students covered a four year sequence. They were exposed to such topics as negative numbers, number sentences, the solution of equations with one and two unknowns, congruency of triangles, Pythagorean property of right triangles, selected topics from solid geometry, measurement of volume and surface areas, decimal system of numeration, scientific notation, the use of exponents, permutations, combinations and basic probability theory.

e. UICSM-7 -- This program, designed for average ninth graders, was begun two years earlier than normal. In general, the program stresses a "discovery" method, and much time and attention was devoted to exploring differences between number and numeral, developing the essential principles which govern the operations of arithmetic numbers, and using new descriptive language to express mathematical ideas in order to help students acquire the concepts and manipulative skills necessary for the further study of mathematics. The classes in this program completed Units I, II, III, IV, VII, and V.

f. UICSM-8 -- These classes followed essentially the same program as did the SMSG-Accelerated during the seventh grade. They then began the ninth grade UICSM Program in eighth grade -- a year earlier than is normal and completed Units I, II, III, IV.

A Summary of Differences and Similarities Among Programs.

Some content was common to all the programs, especially in the area of number concepts and the four fundamental arithmetic operations. However, while both standard courses emphasized "social utility" of mathematics, the contemporary courses (SMSG and UICSM) emphasized the "structure" of mathematics. Both contemporary courses gave instruction, although to varying degrees, in both metric and non-metric geometry using language derived from set theory; the two standard courses paid less attention to language precision and pupils proceeded directly to solve problems based on algorithms or models found in their textbooks.

UICSM program content, using a "non-verbal awareness method of discovery", differed in teaching methodology from the others. Although Standard-Enriched units included basic ideas covered in the SMSG and UICSM texts, the depth of presentation, the number and variety of experiences afforded pupils, and the time pupils spent studying them were considerably less.

Material available to teachers for assistance in classroom presentation varied. SMSG teachers had extensive materials upon which to rely; UICSM teachers had inserts in their editions of the textbooks which served as teacher aids. In addition, most of them had participated in the extended training program at the University of Illinois. Standard-Enriched teachers only had outlines and sample problems for their "enrichment" units; Standard-Accelerated teachers relied solely on their texts, experience and training.

Population Selection

In order to minimize individual teacher effect, at least five classes were sought for each of the six programs. The number of teachers and classes actually participating at the start of the study are shown by program in Table 2-2. Some teachers taught two classes; but no teacher taught in more than one kind of program.

Table 2-2

Number of School Systems, Schools, Teachers, and Classes in Each of Six Mathematics Programs at the Beginning of the Study.

Program	No. of Systems	No. of Schools	No. of Teachers	No. of Classes
Standard-Enriched	2	7	10	14
Standard-Accelerated	7	7	8	10
SMSG-Normal	4	5	7	8
SMSG-Accelerated	6	6	6	6
UICSM-8 [a]	4	6	7	8
UICSM-7	2	4	5	5
Total	25	35	43	51

[a] SMSG-Accelerated and UICSM-8 Teachers had in-service courses together during the first year since both groups were pursuing comparable programs for the seventh grade.

Nine in-service meetings were conducted during the spring semester before the study began. Some teachers attended only one session; others, two in-service sessions. At these sessions, the study was explained and the appropriate mathematics programs were discussed, including examination of materials, content, techniques and sequence. In-service meetings were continued throughout the study with a total of 25 sessions during the seventh grade, 23 during the eighth grade, and 10 during the ninth grade.

The purpose of the in-service program was twofold: 1) to insure that teachers understood what was expected of them in teaching the content prescribed for their particular program by instructing them in mathematical content and method and 2) to coordinate certain administrative details such as maintaining the teaching-learning pace desired and developing teacher-made tests.

The following consultants taught in the in-service courses:

Standard Enriched: Leonard Simon - Curriculum Consultant in Mathematics for the Bureau of Curriculum Research, New York City Public Schools. Dr. Simon had served as instructor in several National Science Foundation summer institutes and had consulted with writing groups at Eugene, Oregon. He wrote or selected the enrichment units for the program and instructed the teachers in their use.

SMSG-Normal and SMSG-Accelerated (UICSM-8, Grade 7): Harry Ruderman - Chairman of the Mathematics Department at Hunter College High School, New York City, and Director of the SMSG film series. Dr. Ruderman was actively involved in shaping the SMSG Program.

UICSM-8 (in Grades 8 & 9) and UICSM-7: Arnold Peterson - Chairman of the Mathematics Department at the Pascack Valley Regional High School, New Jersey. Mr. Peterson was actively involved with the UICSM program, serving both as one of the writers and as an instructor in UICSM curriculum at the University of Illinois and at Wayne State University.

Standard Accelerated: Miriam Goldberg and A. Harry Passow, Research Associates, and Robert D. Neill and John P. Downes (both Mathematics majors), Research Assistants, at the Horace Mann-Lincoln Institute.

Criteria for Selection of Pupils.

As indicated earlier, the selection of pupils involved the following: 1) intelligence test scores, 2) reading achievement, and 3) mathematics achievement. To be included in the study, pupils had to have a minimum IQ of 120 as measured by the Lorge-Thorndike Verbal Intelligence Test, and reading and mathematics achievement scores at least one-and-a-half years above grade placement as measured by the STEP Tests, Form 3, at the end of Grade 6. Students whose converted STEP-Reading and STEP-Mathematics scores fell at or above the fiftieth percentile on the basis of eighth grade norms were eligible.

Approximately 2,500 sixth grade students in all the participating schools other than New York City were tested in the Spring of 1962. The total of 7,785 tests administered included 2,556 Lorge Thorndike Verbal Intelligence Tests, 2,387 STEP Reading Tests and 2,389 STEP Mathematics Tests. The New York City pupils, who were selected from those who qualified for the three-year Special Progress Program, were not "pre-tested" until they were enrolled in their seventh grade Special Progress classes the following Fall. The selected population totaled 1,520 students. Normal attrition reduced to 1, 477 the number of pupils who completed the seventh grade. The number of classes and the number of pupils participating in each of the six programs at the end of the seventh grade (June, 1963) is given in Table 2-3.

During the first year (seventh grade) some students were added to the experimental classes by their schools. Where possible, complete pre-test data were gathered on these pupils. Only where data were available to indicate that they met all the criteria were these students included in the analyses.

Table 2-3

Means and Standard Deviations of Initial Scores on Lorge-Thorndike Verbal Intelligence Test, STEP-Reading and STEP-Mathematics Tests of Pupils Who Completed Grade 7 in Each of Six Mathematics Programs.

Programs	No. of Classes	No. of Pupils	L-T IQ Mean	L-T IQ S.D.	STEP-Reading Mean	STEP-Reading S.D.	STEP-Math Mean	STEP-Math S.D.
Standard-Enriched	14	465	125.72	9.43	49.92	6.02	29.60	5.67
Standard-Accelerated	10	279	132.63	8.78	52.09	6.11	32.97	5.37
SMSG-Normal	8	213	131.87	9.06	52.26	5.61	32.88	5.53
SMSG-Accelerated	6	165	133.64	7.34	53.28	5.15	33.30	4.70
UICSM-8	8	212	130.64	8.13	51.27	5.71	32.36	5.96
UICSM-7	5	143	130.70	7.40	52.20	5.73	32.17	5.34
Total	51	1477	129.92	9.14	51.46	5.92	31.78	5.68

Although the average scores on the intelligence, reading and mathematics tests in each of the six programs fell within the expected ranges, individual class means differed both across all six programs and within each program.

The mean verbal intelligence score as measured by the Lorge-Thorndike Verbal Intelligence Test, for the population was 129.92. Program means ranged from IQ 125.72 in the Standard-Enriched Program to IQ 133.64 in the SMSG-Accelerated Program. After combining the SMSG-Accelerated classes and the UICSM-8 classes since both were following the same program in the seventh grade, the range of program IQ means extended from 125.72 to 132.63. For the seventh grade analyses the SMSG-Accelersted and UICSM-8 classes were treated as a single "program."

Using raw scores, the mean reading achievement, as measured by STEP-Reading, Form 3A, for the total population was 51.46, a score which placed a pupil within the 85-96 percentile band on eighth grade norms. The lowest classroom mean raw score for reading, 40.00, placed a pupil in the 53-72 percentile band on eighth grade norms.

The mean raw score in arithmetic for the total population, as measured by STEP-Mathematics, Form 3A, was 31.78. This score fell within the 84-93 percentile band of eighth grade norms. The lowest classroom mean score of 29.60 fell within the 50-74 percentile band in the eighth grade table of norms.

As pointed out earlier, pupils in the Standard-Enriched Program from New York City Special Progress Classes were "pre-tested" in the Fall of 1962, after they had been enrolled in their classes. Presumably, they had already met similar criteria for selection for the SP Classes. It was too late then to adjust classes and, consequently, mean scores for the Standard-Enriched classes were lower than the means for other classes. One classroom mean fell below IQ 120, and seven others fell below IQ 127. However, the reading achievement and the arithmetic achievement means in these classes were above the lower limit required by the selection criteria.

Other Initial Assessment Procedures

Since other pupil-related factors such as interests, socio-economic status, attitudes, and pupil appraisals of their own abilities were believed to affect achievement, personal and background data were collected using the following instruments developed by the TYP staff:

Questionnaire on Mathematics is a revision of an attitude inventory adapted for use in the Cheltenham Study.[1] The sixty-eight items in the inventory fall into six categories of attitudes: I) the impact of mathematics on society, II) characteristics of mathematicians, III) mathematics as a career, IV) the nature of mathematics, V) mathematical ability and interest, and VI) school effectiveness in teaching mathematics.

Personal Data Inventory asked the pupil for information about his parents' education and employment, his activities outside of school, his educational and professional aspirations, his likes and dislikes in school subjects and activities. In addition, a 25 item self-appraisal instrument was included. Information from the Personal Data Inventory was used to assign each pupil a socio-economic status rating based on the Hamburger scale.[2] The self-appraisal measure was developed by Goldberg, and a test-retest reliability coefficient of .78 was reported.[3]

The Questionnaire on Mathematics and the self-appraisal instrument were readministered at the end of ninth grade as part of the post-testing program.

Means and standard deviations for pre-test variables other than IQ, Reading and Math are presented by program in Table 2-4.

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[1] The Questionnaire was adapted from an attitude scale by Hugh Allen, Jr., (Attitudes of Certain High School Seniors Toward Scientific Careers, New York: Bureau of Publications, Teachers College, Columbia University, 1959, pp 47-50.) A reliability study of the Questionnaire on Mathematics based on the responses of about 100 seniors in Cheltenham and 300 seniors in Kentucky secondary schools, produced split half reliabilities of the order of .45 for Categories I, II, III, IV, and VI. For Category V and for the Total Score, higher coefficients (.77 for Category V and .74 for Total Score) were obtained. Validity checks in the Kentucky sample (using comparisons of teacher assessment score with Total Score and Category V score) were .60.

[2] Martin Hamburger, "A Revised Occupational Scale for Rating Socio-economic Class," a scale developed in the Career Patterns Study, Horace Mann-Lincoln Institute of School Experimentation, Teachers College, Columbia University, May, 1957 (unpublished).

[3] Miriam L. Goldberg, "A Three-year Experimental Program at De Witt Clinton High School to Help Bright Underachievers," High Points, New York City Board of Education, 1959. pp. 5-35.

Table 2-4

Means and Standard Deviations of Selected Pre-Test Variables For Pupils Who Completed Grade 7 in Each of Six Mathematics Programs.

			Pre-Test Variables							
			Total Attitudes Toward Math		Attitudes Toward Own Math Experiences		Father's Occupation		Appraisal Self-Ability	
Programs	No. of Classes	No. of Pupils	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Std. Enr.	14	465	38.65	9.58	11.59	4.51	3.42	1.42	47.88	9.72
Std. Accel.	10	279	40.06	8.79	12.22	1.32	2.88	1.32	50.29	10.54
SMSG-Normal	8	213	38.46	9.27	11.09	4.19	2.94	1.33	50.83	9.59
SMSG-Accel.	6	165	39.21	10.26	11.78	4.50	2.77	1.49	51.83	9.80
UICSM-8	8	212	37.61	8.90	10.98	4.25	2.50	1.30	51.70	10.04
UICSM-7	5	143	36.51	9.54	10.59	4.38	2.52	1.49	52.00	9.81
Total	51	1477	38.58	9.40	11.47	9.34	2.96	1.43	50.15	10.07

For the total population, the average pupil age was 12 years. Attitudes towards mathematics were slightly positive, suggesting generally favorable arithmetic experiences in the elementary grades. On the whole, students came from upper-middle class families as judged by an index which considered the father's occupation, education, and income. Most mothers were not employed outside the home. Although fathers held more undergraduate and graduate degrees than mothers, differences in the educational level of the parents were not very great.

Both boys and girls aspired to a college education and to employment at a level higher than their parents'. Pupils reported that they spent 8 hours per week on homework, wished for 66% of their school work to contain hard-core academic subjects, and wanted the other 34% spread among classes or activities in music, art, home economics, shop, dramatics, study, library, clubs, and lunch. If allowed to plan their own school schedules, pupils stated a preference for 5 hours of mathematics instruction per week or approximately one-sixth of their total school time.

Pupil activities outside of school included free reading, music and dancing lessons, scouting, art school, sports, and hobbies. On the average, pupils spent approximately 6 hours each week on free reading, 2½ hours on music activities, and more than 2 hours on other activities.

Pupil attitudes toward their own abilities were generally positive. Given a choice of <u>very good</u>, <u>good</u>, <u>fair</u>, <u>poor</u>, and <u>very poor</u>, pupils considered their mathematics ability <u>good</u>; however, they rated their ability to meet and to accept responsibility for themselves and others as <u>poor</u>. However, in viewing their intellectual abilities (i.e. thinking clearly, solving problems, expressing ideas, seeking knowledge eagerly and exercising judment) pupils rated themselves from <u>good</u> to <u>very good</u>. Pupils saw themselves as socially competent and rated their self-confidence, decision-making ability, social adaptability and perseverance as <u>good</u> to <u>very good</u>.

<u>Assessment of Pupil Achievement Across Programs</u>

To compare the mathematics achievement of groups of pupils exposed to different content required special tests. Tests based on traditional mathematical content could not adequately assess the achievement of pupils in contemporary programs and <u>vice versa</u>. Therefore, for each of the three years, the Educational Testing Service (ETS), Princeton, New Jersey, constructed two kinds of achievement examinations: 1) a measure of developed mathematical ability which was relatively independent of the specific content of any program and 2) a measure of mathematical attainment which included more or less equal representation of the material taught in each of the programs. In addition to the two ETS tests, teachers and consultants in each program developed end-of-year examinations (referred to as the Teacher-Made Tests) which measured the specific content taught in a given program during the year. Two of the three criterion measures: the Developed Mathematical Ability Test, (ETS-I) and the cross-program Mathematics Achievement Test, (ETS-II), were used in assessing pupil performance both across-programs and within-program. The Teacher-Made Tests were analyzed only within each program.

Both ETS examinations were field tested in January, 1962, in classes of gifted seventh, eighth, and ninth grade students who were at that time participating in programs of the same type as those included in the study. The ninth grade sample had been in the same course of study for three years; the eighth grade students, for two years; and the seventh grade students were in their first year of a program. Alternate forms of both tests were administered to 600 pupils in the three grade levels. Split half reliability for ETS I was .60; for ETS-II, .72.

The three forms of the Developed Mathematical Ability Tests (ETS-I) each contained 30 items which assessed the ability to perceive quantitative relationships, apply definitions and agreements to problem solving, perform various mathematical operations, and conceptualize spatial relationships. No validation data are available, and the test items are still under security.

Each of the three Mathematics Achievement Tests (ETS-II) contained 40 items drawn in sets of six to eight items from the specific content of each of the various programs taught in the TYP study. Thus, each pupil's achievement was measured by his ability to solve problems derived from content which he had been taught as well as his ability to solve problems derived from content other than his own. Analyses were performed for the total scores as well as for each of the sub-test scores. No validation data are available, and test items are still under security.

The Teacher-Made Tests examined the achievement of pupils in content specifically taught to them in their classes. Items were distributed proportionately among topics according to weights decided upon by the teachers. At the end of the seventh year, except for Standard-Enriched pupils, each student took a two-part, 60-item examination composed by the consultants to the particular program from questions submitted by the participating teachers. Standard-Enriched pupils took a one-part, 34-item examination. In all cases only the first twenty-five questions answered by a pupil on a part-test constituted his score for that part of the test. Correct responses from the two parts were averaged, and a single score was assigned to each pupil from the results. No validation data were obtained; however, it is assumed that the tests constituted valid measures since all teachers were in agreement as to the areas to be tested and the percentage of the test which would be devoted to any one area. Before averaging the scores on Parts I and II and considering a single score for purposes of analysis, a coefficient of reliability was computed using a split-half formula.

At the end of eighth and ninth grades, the Teacher-Made Tests were uniform in length. Each test was made up of 25 items and administered to the pupils in each of the programs, at a single sitting.

Regression of Pupil Raw Scores at the End of the Seventh Grade

Since pupil ability, social status, attitudes toward mathematics and self-ratings scores on tests used for pupil selection varied from classroom to classroom within and among the six mathematics programs, raw scores on the criterion measures could not be relied upon to assess the differential effects of the various programs. Seven variables were selected as theoretically relevant to pupil achievement and were included in a multiple regression equation.

Residual scores were then used in the analysis[a] which had the effect of controlling for some of the individual pupil variability. The seven pupil attributes selected for the regression equation were: (1) intelligence as measured by the Lorge-Thorndike Verbal Intelligence Test, (2) initial reading achievement obtained from scores on the STEP-Reading Test, (3) initial arithmetic achievement as measured by the STEP-Mathematics Test, (4) attitudes toward mathematics, as measured by the total score of the Questionnaire on Mathematics (5) attitudes toward one's own ability and interest in mathematics (Category V of the Questionnaire), (6) socio-economic status, using the Hamberger scale, and (7) pupil assessment of his own abilities, from the 25 item self-rating scale. Tables 2-3 and 2-4 present the means and standard deviations of the seven independent variables by program. Table , Appendix , presents the means and standard deviations for all 34 pupil attributes measured at the outset of the study and Tables 3.& 3a, Appendix B, presents an intercorrelational matrix of the 34 pupil attributes.

Regression data for each test for each year of the study were obtained using the IBM 7094 Computer programmed for the Harvard Statistical Laboratory Ultimate Regression routine. A priori specification of independent, dependent non-enterable variables produced an output which listed for each equation: (a) the number of observations, (b) the number of variables in the basic correlation matrix from which the equation was selected, (c) the Multiple R, (d) the R^2 corrected for degrees of freedom, (e) the constants, (f) the beta weights, (g) the partial regression coefficients, (h) the corrected scores, (i) the

[a] Analyses of residual scores rather than covariance analyses were used because there was no computer program available for an analysis which required seven co-variates and unequal replications in the cells.

residual scores and (j) the percentage of error. For ETS-I and ETS-II regression was based on the total population. For the Teacher-Made Tests, regression analyses were performed within program.

In summary, the testing program consisted of the following:

Pre-Test -

Lorge-Thorndike Verbal Intelligence Test
STEP - Reading, Form 3
STEP - Mathematics, Form 3
Questionnaire on Mathematics (Attitude Inventory)
Personal Data Inventory

End of Seventh Grade

ETS-I - Developed Mathematical Ability Test, Form LTM, Part I
ETS-II - Mathematics Achievement Test, Form LTM, Part II
Teacher-Made Tests

End of Eighth Grade

ETS-I - Developed Mathematical Ability Test, Form - MTM, Part I
ETS-II - Mathematics Achievement Test Form MTM, Part II
Teacher-Made Tests

End of Ninth Grade

ETS-I - Developed Mathematical Ability Test, Form NTM, Part I
ETS-II - Mathematics Achievement Test, Form NTM, Part II
Teacher-Made Tests
Questionnaire on Mathematics
Self-Rating Scale (from Personal Data Inventory)

The initial population and class organization were pretty well maintained during the seventh and eighth grades. At the beginning of seventh grade there were 1526 students involved. By the end of the seventh grade, the number on whom complete data were available had dropped to 1477, mostly due to student transiency. By the beginning of eighth grade, two of the 14 Standard-Enriched classes dropped out. Over the summer, there was additional attrition, so that 1356 pupils were left. To this, 34 students (fully qualified) were added, bringing the total number to 1390. There was additional loss during the eighth grade year so that complete data were available at the end of the year for 1271 pupils in 49 classes.

However, between eighth and ninth grades, problems arose which caused major losses in classes, programs and students. A change in the New York State syllabus which represented a shift in content emphasis from what had previously been regarded as "standard" resulted in the loss of some standard accelerated classes. Other classes moved into a geometry program instead of second year algebra as anticipated. In addition, plans to transfer intact three classes from junior high eighth grade to two four-year regional high schools failed to materialize when the building program lagged. These classes could not be kept intact and had to be withdrawn from the study. By the end of ninth grade, the number of classes had dropped to 37 and the number of students participating in the final testing program had dwindled to 905, with complete and usable data for all three years available on 868.

Treatment of the Data

At the end of each of the three years of the study, analyses were made of both raw and residual scores on the two ETS tests across and within programs and of the Teacher-Made Tests within programs. The data for each year were treated independently without regard to pupil status at the end of the preceding year. Only the initial data on intelligence, reading, arithmetic, attitudes toward mathematics, socio-economic status and self-rating on abilities were considered each year and included in the multiple regression analyses for each test - yielding sets of residual scores - which were then analyzed. To derive some measure of the degree to which controlling for initial pupil status affected class standing on the various tests, rank order correlations were performed between class means on raw and residual scores.

In addition to the total scores on the three instruments, sub-scores from the ETS-II tests were also analyzed across and within programs. These analyses provided a measure of the degree to which particular programs were more or less instrumental in enabling pupils to apply what they had been taught to content to which they had not been directly exposed.

Finally, to derive an estimate of achievement over the three year period a longitudinal ranking procedure was applied to individual residual scores for each ETS test each year and the summed pupil ranks across years and across both ETS tests were subjected to a Chi square analysis across programs.

The effects of the several programs on attitudes toward mathematics and on self-rating of abilities were assessed through analyses of covariance of ninth grade scores with seventh grade scores as the covariate.

Hypotheses Tested in the TYP Study

1. Rapid sequential progress through a mathematics program is more effective than plans which provide either intermitten enrichment units even when these are of an advanced nature or a depth study of normally paced sequential material. Accelerated sequential programs will result in (a) greater general mathematical competence, (b) greater ability to apply knowledge to unfamiliar mathematical materials, and (c) more positive attitudes toward mathematics, than will be true of the other approaches.
2. Programs which deal with contemporary mathematical content and methodology will result in greater gains in (a) general mathematical competence, (b) ability to apply knowledge to unfamiliar mathematical materials and (c) more positive attitudes toward math than will be true for programs which follow a standard sequence, regardless of pace.

CHAPTER III

Results at the End of Grade Seven.

In the fall of 1962, the pupils who had been selected the previous spring entered the seventh grade and the TYP-Mathematics Study began its three-year junior high school classroom phase. At the beginning of the seventh grade, there were 51 classes and six mathematics programs. Since the UICSM-8 and SMSG-Accelerated classes followed essentially the same content during the year, they were treated as part of a single program for purposes of in-service training, item selection for ETS II and for some of the analyses. The number of pupils at the beginning of the year was 1520. However, complete, usable data at the end of seventh grade were available for 1477 pupils. Since some of the teachers taught more than one of the 51 classes, only 43 teachers were involved. A total of 25 in-service training sessions was conducted during this year ranging from three for the UICSM-7 and Standard-Accelerated teachers to six for the SMSG-Normal teachers. The UICSM-8 and SMSG-Accelerated teachers met together for four sessions and the Standard-Enriched for five. (See Table 2-3.)

End of Year Results

The Testing Program

The Developed Mathematical Abilities Test (ETS-I), a 30-item instrument, drew its items from a pool developed for measuring the mathematical ability of eleventh grade students. Thus, the items were generally more difficult than would normally be found in a seventh grade test.

The Mathematics Achievement Test (ETS-II), a 40-item instrument, (eight items drawn from each of the five programs) was designed to measure achievement in the content taught pupils in a specific program and to assess pupil ability to solve problems derived from content taught in other programs. According to the specifications of the test, a pupil was expected to do better on the eight items derived from content taught him than on the remaining items. Correct responses to the "out-of-content" items represented a measure of the pupil's ability to apply concepts learned in his program to the solution of problems dealing with content to which he had not been directly exposed. This test yielded a total score and five sub-scores for each pupil.

Teacher-Made Tests were developed by the teachers and consultants of each program. Except for the Standard Enriched test, which consisted of 34 items and was administered in a single sitting, the seventh grade Teacher-Made Tests were composed ot two parts of 30 items each and administered in two sittings. In all programs, pupils were instructed to answer any 25 items on each part and only the first 25 responses were scored. For those pupils who took the two-part tests, scores were averaged and each pupil was given a single score.

Statistical Treatment of the Data

Raw scores on the three criterion measures were subjected to a multiple regression analysis to control for the seven independent variables discussed in Chapter II: IQ, Reading, Arithmetic, Attitudes toward Mathematics, Attitude Toward Own Mathematical Performance, SES, and Self-Rating on Abilities. Regression of scores on the two cross-program tests (ETS-I and ETS-II) was based on the total population. For the TMT's, regression analyses were performed separately for each program. Table B-1, Appendix B, presents the regression analysis data for ETS-I and ETS-II for all programs combined. Tables B-2 and B-2a, Appendix B, present the regression analyses for each part of the TMT's by program. To arrive at a single residual TMT score for each pupil in those programs which took two parts, the residuals from the two parts of the test re averaged.

Ideally, the data should have been analyzed by an hierarchial nested design, .e. pupils within classes and classes within programs. Since the number of ıpils as well as the number of classes in the five programs was unequal, › nested design could appropriately be used. Hence, for ETS-I and ETS-II ›parate one-way analyses of variance were performed on both raw and residual :ores to assess differential outcomes among as well as within each of the .ve programs. For the TMT's, the analyses were within program only.

Contrasts among means were made by the Scheffe technique (at the .05 level) ıich allows unlimited comparisons among means with unequal N's. In addition › comparing individual program means, the following clusters of programs were ıntrasted throughout the analyses:

Accelerated vs. Enriched - SMSG-Accelerated + UICSM-8, UICSM-7 and Standard Accelerated vs. SMSG-Normal and Standard-Enriched

Contemporary vs. Standard - SMSG-Accelerated, SMSG-Normal, UICSM-8 and UICSM-7 vs. Standard-Accelerated and Standard-Enriched

ıe Developed Mathematical Abilities Test (ETS-I):

Table 3-1 presents means and standard deviations of both raw and residual :ores for each program on ETS-I. A one-way analysis of variance of raw scores ›vealed significant differences among the five mathematics programs. (Table 3-2) ıntrasts between the individual program means and among program clusters found ıat pupils enrolled in SMSG-Accelerated, SMSG-Normal, UICSM-7, and Standard- :celerated Programs scored significantly higher than pupils in the Standard- ıriched Classes. No other differences among programs were found. Cluster ıntrasts revealed that accelerated pupils (SMSG-Accelerated, Standard Accelerat- ı, UICSM-7) did significantly better than enriched pupils (SMSG-Normal and

Table 3-1

Means and Standard Deviations of the Raw and Residual Scores on the Developed Mathematical Abilities Test (ETS-I) at the End of Grade 7.

Program	N	Raw Scores Mean	Raw Scores S.D.	Residuals Mean	Residuals S.D.
Standard Enriched	465	12.71	3.75	-0.736	3.25
Standard Accelerated	279	15.03	3.93	-0.148	3.55
SMSG-Normal	213	15.24	4.30	0.265	3.53
SMSG-Accelerated + UICSM-8	377	15.83	3.91	0.778	3.31
UICSM-7	143	15.00	4.01	0.233	3.28
Total	1477	14.53	4.14	0.000	3.36

Table 3-2

Analysis of Variance of Raw Scores on the Developed Mathematical Abilities Test of Pupils in Five Mathematics Programs at the End of the Seventh Grade

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	2,384	4	596.00	37.88 [a]
Within Groups	23,156	1472	15.73	
TOTAL	25,530	1476		

Scheffe Tests

PROGRAM	1	2	3	4	5
1 STD-ENR		-2.32 [a]	-.253 [a]	-3.12 [a]	-2.29 [a]
2 STD-ACC					
3 SMSG-N					
4 SMSG-ACC & UICSM-8					
5 UICSM-7					

Enriched vs. Accelerated = -1.90 [a]

Standard vs. Contemporary = -1.92 [a]

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[a] Significant at or beyond the .05 level.

Table 3-3

Analysis of Variance of the Residual Scores on the Developed Mathematical Abilities Test of Pupils in Five Mathematics Programs at the End of Grade Seven

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	509.39	4	124.85	11.14 [a]
Within Groups	16,480.67	1472	11.20	
TOTAL	16,990.06	1476		

Scheffe Tests

PROGRAM	1	2	3	4	5
1 STD-ENR			-1.00 [a]	-1.51 [a]	
2 STD-ACC					
3 SMSG-N					
4 SMSG-ACC &UICSM-8					
5 UICSM-7					

Enriched vs. Accelerated = n.s.

Standard vs. Contemporary = -1.04 [a]

[a] Significant at or beyond the .05 level.

Standard-Enriched); and pupils in contemporary mathematics programs (SMSG and UICSM) did better than pupils in standard classes (Standard-Accelerated and Standard-Enriched).

When the residual scores were analyzed (See Table 3-3) across programs, the obtained *F*-ratio was again significant beyond the .05 level. However, when initial pupil status was held constant, contrasts among program and cluster means found that the Standard-Enriched Program fell significantly below only the two SMSG-Programs and pupils in the contemporary-program cluster did significantly better than those in the standard-program cluster. No other comparisons reached significance.

The two highest (SMSG-Accelerated + UICSM-8 and SMSG -Normal) and the lowest (Standard Enriched) retained the same rank position on the residual as on the raw scores. However, Standard Accelerated and UICSM-7 changed places with the latter moving up from 4th to 3rd place.

The Mathematics Achievement Test (ETS-II):

Table 3-4 presents the means and standard deviations of raw and residual scores on ETS-II. The analysis of the raw scores by program yielded a significant *F* ratio. (See Table 3-5.)

Table 3-4

Means and Standard Deviations of the Mathematics Achievement Test (ETS-II) Raw and Residual Scores for Pupils in Five Mathematics Programs at the End of Grade 7.

	Raw Scores			Residuals	
Program	N	Mean	S.D.	Mean	S.D.
Standard Enriched	465	13.12	4.00	-1.446	3.50
Standard Accelerated	279	16.16	3.10	-0.513	3.67
SMSG-Normal	213	16.77	4.89	0.379	3.84
SMSG-Accelerated & UICSM-8	377	18.44	4.36	1.901	3.72
UICSM-7	143	16.36	3.78	0.182	3.81
Total	1477	15.89	4.70	0.000	3.67

Table 3-5

Analysis of Variance of the Raw Scores on the Mathematics Achievement Test (ETS-II) for Pupils in Five Mathematics Programs at the End of Grade Seven.

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	8,301	4	2075.25	83.66 [a]
Within Groups	36,509	1472	24.80	
TOTAL	44,810	1476		

Scheffe Tests

PROGRAM	1	2	3	4	5
1 STD-ENR		-3.04 [a]	-3.65 [a]	-5.32 [a]	-3.24 [a]
2 STD-ACC				-2.28 [a]	
3 SMSG-N				-1.67 [a]	
4 SMSG-ACC & UICSM-8					2.08 [a]
5 UICSM-7					

Enriched vs. Accelerated = -3.00 [a]

Standard vs. Contemporary = -3.29 [a]

[a] Significant at or beyond the .05 level.

Table 3-6

Analysis of Variance of the Residual Scores on the Mathematics Achievement Test(ETS-II) for Pupils in Five Mathematics Programs at the End of Grade Seven.

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	2,442.85	4	610.71	47.34 [a]
Within Groups	18,992.18	1472	12.90	
TOTAL	21,435.03	1476		

Scheffe Tests

PROGRAM	1	2	3	4	5
1 STD-ENR		-.93 [a]	-1.82 [a]	-3.35 [a]	-1.63 [a]
2 STD-ACC				-2.41 [a]	
3 SMSG-N				-1.52 [a]	
4 SMSG-ACC & UICSM-8					1.72 [a]
4 UICSM-7					

Enriched vs. Accelerated = -1.62 [a]

Standard vs. Contemporary = -2.21 [a]

[a] Significant at or beyond the .05 level.

Contrasts among program and cluster means found that the SMSG-Accelerated and UICSM-8 pupils scored significantly higher than the pupils in the other four programs; and SMSG-Normal, UICSM-7 and Standard-Accelerated pupils did better than the Standard-Enriched pupils, but the three higher-scoring programs did not differ significantly from each other.

Cluster contrasts revealed that accelerated pupils did better than enriched pupils and those in contemporary programs did better than their counterparts in the standard programs.

ETS-II - Residual Scores. Analyses of pupil residual scores on the *Mathematics Achievement Test* across programs also yielded a significant *F* ratio. (See Table 3-6). Contrasts among residual program means showed that pupils in the SMSG-Accelerated program scored significantly higher than pupils in the other four programs, while those in the Standard Enriched performed significantly lower than pupils in all other programs. No significant differences were found among the SMSG-Normal, UICSM-7, and Standard-Accelerated programs. Cluster contrasts found the accelerated programs superior to the enriched and the contemporary superior to the standard.

All programs retained the same rank position on both raw and residual scores.

Sub-Test Analyses, ETS-II - Raw Scores. Each of the five sub-tests of which the *Mathematics Achievement Test* was composed included eight items. Each sub-test was constructed from the course of study of one of the programs in the study and was intended to test the material most characteristic of and particularly emphasized in each program.

Table 3-7 presents the raw score means, ranks and standard deviations for each program on each of the five sub-tests. Logically, each program should

Table 3-7

Means, Ranks and Standard Deviations of Raw Scores on Five Sub-tests of ETS-II for Each of the Six Mathematics Programs at the End of Grade Seven

Programs	I			II			III			IV [a]			V		
	$\bar{X}$	Rank	S.D.	$\bar{X}$	Rank	S.D.	$\bar{X}$	Rank	S.D.	$\bar{X}$	Rank	S.D.	$\bar{X}$	Rank	S.D.
St. Enr.	3.60[b]	1	1.32	3.50	2	3.37	3.17	1	1.57	1.66	1	1.13	1.39	1	1.06
St. Acc.	4.45	4	1.18	3.57[b]	3	1.30	3.64	2	1.44	2.22	2.5	1.10	2.26	3	1.40
SMSG-Nor.	4.40	3	1.35	3.67	4	1.31	4.37[b]	5	1.66	2.22	2.5	1.23	2.14	2	1.38
SMSG-Acc.	4.76	5	1.09	3.83	5	1.47	4.99	6	1.26	2.92[b]	6	1.13	2.47	5	1.23
UICSM-8	4.87	6	1.44	3.94	6	1.48	4.26	4	1.35	2.63[b]	4	1.31	2.29	4	1.50
UICSM-7	4.29	2	1.40	2.62	1	1.18	3.82	3	1.29	2.67	5	1.07	2.98[b]	6	1.36

[a] Sub-test IV was applicable to both SMSG-Accelerated and UICSM-8.

[b] Sub-test composed of the material taught in the particular program.

have scored higher on its own sub-test than on any other and each should have had a higher mean on its own eight items than on any other set of eight. However, this was not the case. Inspection of the cells along the diagonal of the table (marked with a b) indicates that neither of these two conditions was consistently met. The scores in the "own" cells were not necessarily the highest either for the row (program) nor for the column (sub-test). Inspection of the rows found that the Standard Enriched pupils were the only ones to achieve their highest score on their own sub-test; in all the other programs, pupils did better on sub-tests other than their own. Actually, all groups, except SMSG-Accelerated, did best on the Standard Enriched sub-test and SMSG-Accelerated pupils received their highest scores on the SMSG-Normal sub-test. Inspection of the columns found that only on Sub-tests IV and V were the highest scores achieved by the pupils in the programs on which the tests were based. SMSG-Accelerated ranked first on Sub-test IV (however, UICSM-8, for whom Sub-test IV was equally appropriate did not rank 2nd.) and UICSM-7 ranked first on Sub-test V. Thus, on every sub-test except V, SMSG-Accelerated or UICSM-8 held first rank.

Analyses of variance of each of the sub-tests across the six program groups yielded significant $\underline{F}$ ratios in every case. (See Tables B-4a through B-4e in Appendix B.)

On Sub-test I each of the other five programs did significantly better than Standard Enriched from whose course of study the test was constructed. In addition, UICSM-8 exceeded Standard Accelerated, SMSG-Normal and UICSM-7. Both cluster contrasts were significant. The contemporary and the accelerated programs exceeded their counterparts. On Sub-test II, scores for the first five groups differed little and each did significantly better than UICSM-7. Thus, the pupils studying first year UICSM mathematics were least able to cope with the accelerated standard material. Neither of the cluster contrasts reached significance. On Sub-test III (derived from the SMSG-Normal course of study) twelve of the fifteen program contrasts reached significance. SMSG-Accelerated exceeded each of the other five programs whereas Standard Enriched fell below each of the others. Only the contrast between Standard Accelerated and UICSM-7, SMSG-Normal and UICSM-8; and UICSM-7 and UICSM-8 were not significant. Both cluster contrasts were significant with the accelerated and the contemporary higher than the enriched and the standard, respectively.

On Sub-test IV (based on SMSG-Accelerated materials) eleven of the fifteen program contrasts reached significance as did both cluster contrasts. SMSG-Accelerated, UICSM-8 and UICSM-7 each exceeded both standard programs and SMSG-Normal. In addition, both Standard Accelerated and SMSG-Normal had higher mean scores than Standard Enriched. The accelerated cluster exceeded the enriched; the contemporary exceeded the standard.

On Sub-test V (developed from the UICSM-7 course of study) the UICSM-7 pupils on the average scored significantly higher than pupils in each of the other programs. Standard Enriched fell significantly below each of the other programs. As on the other sub-tests, the accelerated and the contemporary programs exceeded their counterparts.

Summary. On the basis of the raw score sub-test analyses, there was no consistent relationship between membership in a particular program and scores on the sub-test ostensibly derived from the material of that program. The sub-tests apparently differed in inherent difficulty, since all pupils, regardless of program, scored consistently higher on some, such as I and III than they did on IV or V.

In all cases but Standard Enriched, program means were higher on out-of-program sub-tests than on sub-tests derived from the program. These findings raise serious questions about the validity of the test for measuring cross-content competence. However, to the extent that the test sampled from the several different courses, the pupils in the SMSG-Accelerated and UICSM-8 classes (all of whom studied comparable material) were generally better able to handle the varied content than were the pupils in the other programs. When the ranks were summed across the five sub-tests for each program, SMSG-Accelerated had a sum of ranks of 27; UICSM-8 a sum of 24; UICSM-7 and SMSG-Normal, 17 and 16.5 respectively; Standard Accelerated, 14.5 and Standard Enriched, 6.

Sub-Test Analyses - ETS-II - Residual Scores. The extent to which the rogram differences observed in the raw score analyses were due to differences n pupil ability or attitudes can be seen from the analyses of residual cores. Table 3-8 presents program means, ranks and standard deviations for ach of the five sub-tests. Actually, the status of the three accelerated ontemporary programs remained virtually unchanged, since each of the three etained the same position on both raw and residual score rank-orders. There ere some shifts among the other three programs. In no case was there a shift f more than one place in the rank order.

Analyses of variance perfomed on each of the sub-tests across programs ielded significant F ratios in each case. (See Tables B-5a - B-5e, Appendix B) ost of the program contrasts which were significant in the raw score analyses, lso reached significance in the residual analyses.

On Sub-test I (Standard Enriched) Standard Enriched was exceeded by tandard Accelerated, SMSG-Accelerated and UICSM-8, and the latter exceeded ll other program groups, as well.

On Sub-test II (Standard Accelerated) UICSM-8 exceeded both Standard rograms and UICSM-7 fell significantly below all others.

On Sub-test III (SMSG-Normal) both SMSG programs and UICSM-8 exceeded both tandard programs; and SMSG-Accelerated exceeded SMSG-Normal and both UICSM rograms.

On Sub-test IV (SMSG-Accelerated and UICSM-8) SMSG-Accelerated, UICSM-8 nd UICSM-7 each exceeded Standard Enriched, Standard Accelerated and SMSG-Normal.

On Sub-test V UICSM-7 exceeded each of the other programs. In addition, tandard Enriched fell significantly below all others.

Cluster analyses found the accelerated significantly superior to the nriched programs on Sub-tests I, IV and V and the contemporary significantly uperior to the standard on Sub-tests I, III, IV and V.

Table 3-8

Means, Ranks and Standard Deviations of Residual Scores
on Five Sub-tests of ETS-II for Each of Six Mathematics Programs
at the End of Grade Seven

Programs	Sub Tests: I			II			III			IV [a]			V		
	$\bar{X}$	Rank	S.D.	$\bar{X}$	Rank	S.D.	$\bar{X}$	Rank	S.D.	$\bar{X}$	Rank	S.D.	$\bar{X}$	Rank	S.D.
St. Enr.	-0.3438 [b]	1	1.21	0.0220	3	1.26	-0.3569	2	1.43	-0.3568	1	1.10	-0.4033	1	1.08
St. Accel.	0.0290	3	1.15	-0.0586 [b]	2	1.17	-0.4125	1	1.44	-0.1131	2	1.10	0.0274	3	1.32
SMSG-Nor.	0.0330	4	1.18	0.0960	4	1.22	0.3820 [b]	5	1.45	-0.0635	3	1.27	-0.0287	2	1.22
SMSG-Acc.	0.2778	5	1.09	0.1594	5	1.37	0.8622	6	1.17	0.5524 [b]	6	1.10	0.2079	5	1.13
UICSM-8	0.5281	6	1.32	0.4103	6	1.36	0.3285	4	1.24	0.3230 [b]	4	1.28	0.1504	4	1.40
UICSM-7	-0.0372	2	1.32	-0.8864	1	1.03	-0.0990	3	1.19	0.3799	5	1.04	0.8346 [b]	6	1.29

[a] Sub-test IV was applicable to both SMSG-Accelerated and UICSM-8.

[b] Sub test composed of material taught in the particular program.

__Summary.__ In general, analyses of residual sub-test means of the six programs resulted in little change from the observed raw score differences. Rank order correlations between raw and residual means for each of the sub-tests found perfect agreement on Sub-test V; .99 on Sub-test IV and .94 on Sub-tests I, II and III. Controlling for pupil ability and attitudes did little to change the relative status of the six program groups on the five sub-tests. The content to which pupils were exposed continued to be a significant factor in sub-test performance. It appears that the combined SMSG-Accelerated and UICSM-8 program was more effective in preparing pupils to deal with a wide array of mathematical problems than was any of the other programs, while pupils in the two standard programs neither achieved mastery of their own content nor developed the general concepts necessary to tackle the mathematics taught in the other programs.

Within-Program Analyses

Both the raw and residual scores for each of the criterion measures were analyzed by class within program. Rank order correlations were computed between raw and residual class means on each measure. On both ETS-I and ETS-II, intra-program differences between highest and lowest class tended to be greater than differences between highest and lowest scoring program. However, the within-program exceeded the among-program variances only in the case of the SMSG-Normal Program on both tests and the SMSG-Accelerated on ETS-I. None of these differences was significant.

ETS-I Raw Scores. Analyses of variance across classes yielded significant F ratios for all but the UICSM-7 program.(See Tables 3-9 through 3-14 and 3-9a through 3-14a). The latter was also more homogeneous with respect to class means than were the other programs (greatest class mean difference was 2.2 and the among-class variance 33.15) although pupil variability was about as great as for all other programs (within-group variance 15.56). The range of class means was greatest in the UICSM-8 program where the greatest class mean difference was 5.7 and the among-class variance was 112.65. The pupil variability was the lowest for all programs (within-group variance 12.70).

ETS-I - Residual Scores. Differences between highest and lowest class means decreased considerably when residual scores were analyzed. (See Tables 3-15 through 3-20). Neither in the SMSG-Normal nor in the UICSM-7 programs did analyses of variance across classes yield significant F ratios. (See Tables 3-15a through 3-20a) The greatest differences between highest and lowest class means were in the Standard Accelerated (4.6) and in the UICSM-8 (4.4) programs; the differences for the remaining programs were between 2.2 and 2.5 points. The greatest variance among means was found in the combined

Table 3-9

Means, Ranks and Standard Deviations of ETS-I Raw Scores for Classes in the Standard Enriched Program at the End of Grade Seven

Class	N	Mean	Rank	S.D.
1	26	13.27	10	2.91
2	31	12.65	6	4.18
3	36	13.14	9	4.87
4	33	13.67	12	3.46
5	42	12.83	8	3.81
6	44	13.41	11	3.91
7	42	12.70	7	4.17
8	31	10.87	1	3.53
9	37	11.70	3	3.36
10	28	13.68	13	3.96
11	24	14.29	14	3.89
12	27	12.52	5	3.03
13	32	11.53	2	2.87
14	32	12.06	4	2.51

Table 3-9a

Analysis of Variance of ETS-I Raw Scores for Classes in the Standard Enriched Program at the End of Grade Seven

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	354.79	13	27.29	2.00 [a]
Within Groups	6160.17	451	13.66	
TOTAL	6514.96	464		

[a] Significant at or beyond the .05 level.

Table 3-10

Means, Ranks and Standard Deviations of ETS-I Raw Scores for Classes in the Standard Accelerated Program at the End of Grade Seven

Class	N	Mean	Rank	S.D.
1	33	15.00	7	4.53
2	27	14.37	2	3.83
3	30	15.27	8	4.04
4	30	17.67	10	3.74
5	26	13.31	1	3.74
6	24	15.50	9	2.92
7	30	14.67	4.5	4.23
8	23	14.96	6	3.82
9	24	14.67	4.5	3.34
10	32	14.63	3	3.12

Table 3-10a

Analysis of Variance of ETS-I Raw Scores for Classes in the Standard Accelerated Program at the End of Grade Seven

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	316.94	9	35.22	2.38 [a]
Within Groups	3982.83	269	14.81	
TOTAL	4299.77	278		

[a] Significant at or beyond the .05 level.

Table 3-11

Means, Ranks and Standard Deviations of ETS-I Raw Scores for Classes in the SMSG-Normal Program at the End of Grade Seven.

Class	N	Mean	Rank	S.D.
1	30	14.43	3	3.95
2	24	12.54	1	3.94
3	30	13.03	2	3.62
4	24	15.96	6	3.87
5	23	15.74	5	3.95
6	24	15.54	4	4.39
7	30	16.57	7	3.80
8	28	17.36	8	5.57

Table 3-11a

Analysis of Variance of ETS-I Raw Scores for Classes in the SMSG-Normal Program at the End of Grade Seven

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	537.05	7	76.72	4.39 [a]
Within Groups	3579.44	205	17.46	
TOTAL	4116.49	212		

[a] Significant at or beyond the .05 level.

Table 3-12

Means, Ranks and Standard Deviations of ETS-I Raw Scores
for Classes in the SMSG-Accelerated Program
at the End of Grade Seven.

Class	N	Mean	Rank	S.D.
1	27	17.70	4	3.11
2	31	14.97	2	3.96
3	26	18.00	5	3.42
4	28	18.07	6	3.09
5	22	15.36	3	3.81
6	31	14.19	1	5.33

Table 3-12a

Analysis of Variance of ETS-I Raw Scores for Classes
in the SMSG-Accelerated Program
at the End of Grade Seven

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	427.94	5	85.59	5.60 [a]
Within Groups	2430.39	159	15.28	
TOTAL	2858.33	164		

[a] Significant at or beyond the .05 level.

Table 3-13

Means, Ranks and Standard Deviations of ETS-I Raw Scores for Classes in the UICSM-8 Program at the End of Grade Seven

Class	N	Mean	Rank	S.D.
1	29	14.52	3	3.77
2	23	11.78	1	2.86
3	24	17.25	7	3.50
4	27	12.63	2	3.61
5	25	17.44	8	3.75
6	26	16.73	6	3.95
7	29	16.17	5	3.22
8	29	15.96	4	3.65

Table 3-13a

Analysis of Variance of ETS-I Raw Scores for Classes in the UICSM-8 Program at the End of Grade Seven

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	788.55	7	112.65	8.87 [a]
Within Groups	2590.33	204	12.70	
TOTAL	3378.88	211		

[a] Significant at or beyond the .05 level.

Table 3-14

Means, Ranks and Standard Deviations of ETS-I Raw Scores
for Classes in the UICSM-7 Program
at the End of Grade Seven

Class	N	Mean	Rank	S.D.
1	28	14.96	3	4.46
2	29	13.93	2	4.03
3	25	13.80	1	4.40
4	31	16.10	5	3.26
5	30	15.93	4	3.59

Table 3-14a

Analysis of Variance of ETS-I Raw Scores for Classes
in the UICSM-7 Program
at the End of Grade Seven

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	132.60	4	33.15	2.13
Within Groups	2147.40	138	15.56	
TOTAL	2280.00	142		

Table 3-15

Means, Ranks and Standard Deviations of ETS-I Residual Scores for Classes in the Standard Enriched Program at the End of Grade Seven

Class	N	Mean	Rank	S.D.
1	29	-0.5339	10	2.89
2	31	-1.3330	4	3.59
3	36	0.6225	14	3.37
4	33	-0.5686	9	3.31
5	42	-0.9168	8	3.25
6	44	-1.4917	2	3.07
7	42	-0.9238	7	2.91
8	31	0.2003	12	3.15
9	37	0.4855	13	3.34
10	28	-1.2550	5	2.90
11	24	-0.0578	11	3.42
12	27	-1.4399	3	2.66
13	32	-1.8650	1	2.57
14	32	-1.1556	6	2.65

Table 3-15a

Analysis of Variance of ETS-I Residual Scores for Classes in Standard-Enriched Program at the End of Grade Seven

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	268.24	13	20.63	2.00 [a]
Within Groups	4640.48	451	10.29	
TOTAL	4908.72	464		

[a] Significant at or beyond the .05 level.

Table 3-16

Means, Ranks and Standard Deviations of ETS-I Residual Scores for Classes in the Standard Accelerated Program at the End of Grade Seven

Class	N	Mean	Rank	S.D.
1	33	-0.2168	7	3.53
2	27	-0.4806	5	3.01
3	30	0.7036	9	4.17
4	26	2.8193	10	2.89
5	24	-1.7920	1	4.27
6	30	-0.5620	4	2.73
7	23	-1.1892	2	4.08
8	24	0.7027	8	2.70
9	31	-0.4225	6	3.10
10	31	-1.0541	3	3.17

Table 3-16a

Analysis of Variance of ETS-I Residual Scores for Classes in Standard Accelerated Program at the End of Grade Seven

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	393.59	9	43.73	3.78 ✣
Within Groups	3104.88	269	11.54	
TOTAL	3498.47	278		

✣ Significant at or beyond the .05 level.

Table 3-17

Means, Ranks and Standard Deviations of ETS-I Residual Scores for Classes in the SMSG-Normal Program at the End of Grade Seven

Class	N	Mean	Rank	S.D.
1	30	-0.4272	3	3.28
2	24	-0.8834	1	3.09
3	30	-0.7906	2	3.35
4	24	0.9095	7	3.68
5	23	0.9041	6	2.89
6	24	0.2830	4	3.84
7	30	0.8991	5	2.95
8	28	1.3467	8	3.59

Table 3-17a

Analysis of Variance of ETS-I Residual Scores for Classes in SMSG-Normal Program at the End of Grade Seven

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	143.66	7	20.52	1.83
Within Groups	2290.47	205	11.17	
TOTAL	2434.13	212		

Table 3-18

Means, Ranks and Standard Deviations of ETS-I Residual Scores for Classes in the SMSG-Accelerated Program at the End of Grade Seven.

Class	N	Mean	Rank	S.D.
1	27	1.9837	5	3.27
2	31	0.3453	2	3.42
3	26	2.4764	6	2.87
4	28	1.1698	4	3.08
5	22	0.5891	3	2.22
6	31	0.1671	1	3.41

Table 3-19

Means, Ranks and Standard Deviations of ETS-I Residual Scores for Classes in the UICSM-8 Program at the End of Grade Seven.

Class	N	Mean	Rank	S.D.
1	29	-0.4627	3	2.43
2	23	-1.0690	2	2.22
3	24	1.3506	5	2.66
4	27	-2.4114	1	3.16
5	25	1.9478	8	4.38
6	26	1.9282	7	3.19
7	29	1.9256	6	2.99
8	29	1.0334	4	3.06

Table 3-18 + 19a

Analysis of Variance of ETS-I Residual Scores for Classes in the SMSG-Accelerated, and UICSM-8 Programs at the End of Grade Seven.

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	864.60	13	66.51	6.97 [a]
Within Groups	3464.50	363	9.54	
TOTAL	4329.10	376		

[a] Significant at or beyond the .05 level

Table 3-20

Means, Ranks and Standard Deviations of ETS-I Residual Scores for Classes in the UICSM-7 Program at the End of Grade Seven

Class	N	Mean	Rank	S.D.
1	28	0.6893	4	3.23
2	29	-0.8722	1	3.16
3	25	-0.7584	2	4.07
4	31	0.6093	3	2.63
5	30	1.3139	5	2.96

Table 3-20a

Analysis of Variance of ETS-I Residual Scores for Classes in the UICSM-7 Program at the End of Grade Seven

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	105.27	4	26.32	2.43
Within Groups	1418.55	138	10.79	
TOTAL	1523.8[illegible]	142		

SMSG-Accelerated and UICSM-8 programs which, however, had the smallest variation within classes. The smallest inter-class variances were found in the Standard Enriched and SMSG-Normal programs, where intra-class variation was slightly lower than the observed within-group variance across all programs.

ETS-II - Raw Scores. Differences between highest and lowest class means tended to be considerably greater for each program on the ETS-II raw scores than had been true of ETS-I. Variances also appeared greater for most of the programs, but in no case did they differ significantly. The greatest variance among classes occurred in UICSM-8; the smallest inter-class variance was seen in the Standard Enriched program (See Tables 3-21 through 3-26). Analyses of variance across classes yielded significant F ratios for each program (See Tables 3-21a through 3-26a).

ETS-II - Residual Scores. Even when scores were controlled for individual differences on the seven independent variables, significant inter-class differences remained in all the programs. (See Tables 3-27-3-31 and 3-27a-3-31a). In fact, in the Standard Enriched and the Standard Accelerated Programs, high-low class differences increased after regression. Thus, even when given pupils of relatively comparable ability, attitudes and social status, all of whom were exposed to relatively similar content, differences between classes continued to be significant. These differences probably depended on variations in teaching competence, teacher-group interaction and other factors not identified in this study.

Relationship Between Raw and Residual Class Means. To assess the degree to which classes retained their positions within programs after regression, rank order correlations were computed between raw and residual class ranks on both ETS-I and ETS-II. The correlations varied from .07 for Standard Enriched to .93 for SMSG-Normal on ETS-I. On ETS-II, correlations ranged from .29 for Standard Accelerated to .95 for UICSM-8. (See Table 3-32.)

Table 3-21

Means, Ranks and Standard Deviations of ETS-II Raw Scores
for Classes in the Standard Enriched Program
at the End of Grade Seven

Class	N	Mean	Rank	S.D.
1	26	14.96	14	3.88
2	31	13.42	7	3.42
3	36	13.94	11	4.33
4	33	13.64	9	4.67
5	42	12.88	5	4.27
6	44	13.95	12	4.31
7	42	13.52	8	3.56
8	31	12.00	4	3.13
9	37	11.40	1	4.79
10	28	14.00	13	4.27
11	24	13.79	10	4.08
12	27	13.41	6	3.32
13	32	11.47	2	2.79
14	32	11.69	3	2.92

Table 3-21a

Analysis of Variance of ETS-II Raw Scores
for Classes in the Standard Enriched Program
at the End of Grade Seven

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	499.43	13	38.42	2.50 [a]
Within Groups	6939.07	451	15.38	
TOTAL	7438.50	464		

[a] Significant at or beyond the .05 level.

Table 3-22

Means, Ranks and Standard Deviations of ETS-II Raw Scores
for Classes in the Standard Accelerated Program
at the End of Grade Seven

Class	N	Mean	Rank	S.D.
1	33	16.67	8	3.55
2	27	15.15	3	3.62
3	30	16.73	9	3.12
4	30	19.53	10	4.01
5	26	15.23	4	3.89
6	24	13.50	1	2.96
7	30	16.63	7	4.04
8	23	16.56	6	3.89
9	24	14.87	2	3.99
10	32	15.75	5	4.24

Table 3-22a

Analysis of Variance of ETS-II Raw Scores
for Classes in the Standard Accelerated Program
at the End of Grade Seven

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	635.12	9	70.57	4.99 [a]
Within Groups	3805.94	269	14.15	
TOTAL	4441.06	278		

[a] Significant at or beyond the .05 level.

Table 3-23

Means, Ranks and Standard Deviations of ETS-II Raw Scores for Classes in the SMSG-Normal Program at the End of Grade Seven.

Class	N	Mean	Rank	S.D.
1	30	16.27	3	5.10
2	24	13.83	2	4.54
3	30	13.57	1	4.87
4	24	17.92	7	4.37
5	23	17.91	6	4.58
6	24	17.12	4	3.90
7	30	17.70	5	3.68
8	28	19.32	8	6.04

Table 3-23a

Analysis of Variance of ETS-II Raw Scores for Classes in the SMSG-Normal Program at the End of Grade Seven.

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	793.39	7	113.34	5.11 [a]
Within Groups	4547.26	205	22.18	
TOTAL	5340.65	212		

[a] Significant at or beyond the .05 level.

Table 3-24

Means, Ranks and Standard Deviations of ETS-II Raw Scores for Classes in the SMSG-Accelerated Program at the End of Grade Seven.

Class	N	Mean	Rank	S.D.
1	27	19.30	3	3.31
2	31	17.06	2	3.20
3	26	20.77	6	3.69
4	28	20.03	5	3.69
5	22	19.32	4	4.60
6	31	16.71	1	5.72

Table 3-24a

Analysis of Variance of ETS-II Raw Scores for Classes in the SMSG-Accelerated Program at the End of Grade Seven.

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	384.57	5	76.91	4.49 [a]
Within Groups	2726.24	159	17.15	
TOTAL	3110.81	164		

[a] Significant at or beyond the .05 level.

Table 3-25

Means, Ranks and Standard Deviations of ETS-II Raw Scores for Classes in the UICSM-8 Program at the End of Grade Seven.

Class	N	Mean	Rank	S.D.
1	29	16.59	3	4.25
2	23	13.35	1	2.74
3	24	19.79	6	3.94
4	27	15.52	2	2.94
5	25	21.64	7	3.96
6	26	22.42	8	5.45
7	29	17.86	5	3.51
8	29	16.93	4	3.91

Table 3-25a

Analysis of Variance of ETS-II Raw Scores for Classes in the UICSM-8 Program at the End of Grade Seven.

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	1672.62	7	238.95	15.49 ☨
Within Groups	3146.37	204	15.42	
TOTAL	4818.99	211		

☨ Significant at or beyond the .05 level.

Table 3-26

Means, Ranks and Standard Deviations of ETS-II Raw Scores
for Classes in the UICSM-7 Program
at the End of Grade Seven.

Class	N	Mean	Rank	S.D.
1	28	15.18	1	3.73
2	29	15.76	3	3.95
3	25	15.36	2	3.65
4	31	17.03	4	2.96
5	30	18.20	5	3.92

Table 3-26a

Analysis of Variance of ETS-II Raw Scores
for Classes in the UICSM-7 Program
at the End of Grade Seven.

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	190.14	4	47.54	3.56 [a]
Within Groups	1842.95	138	13.35	
TOTAL	2033.09	142		

[a] Significant at or beyond the .05 level.

Table 3-27

Means, Ranks and Standard Deviations of ETS-II Residual Scores for Classes in the Standard Enriched Program at the End of Grade Seven.

Class	N	$\bar{X}$	Rank	S.D.
1	26	0.1160	12	3.28
2	31	-1.8671	6	2.91
3	36	0.2395	13	3.37
4	33	0.9047	14	3.31
5	42	-2.5686	4	3.30
6	44	-2.6778	3	4.41
7	42	-1.4949	9	3.31
8	31	-0.1666	11	3.07
9	37	-0.3600	10	3.11
10	28	-2.3803	5	3.27
11	24	-1.8274	7	3.51
12	27	-1.6737	8	2.99
13	32	-3.2704	1	3.02
14	32	-2.7653	2	2.48

Table 3-27a

Analysis of Variance of ETS-II Residual Scores for Classes in the Standard Enriched Program at the End of Grade Seven.

Source of Variance	Sum of Squares	d.f.	Est. Mean Square	F
Among Means	759.28	13	58.41	5.36 [a]
Within Groups	4909.69	451	10.88	
Total	5668.97	464		

[a] Significant at or beyond the .05 level.

Table 3-28

Means, Ranks and Standard Deviations of ETS-II Residual Scores for Classes in the Standard Accelerated Program at the End of Grade Seven.

Class	N	$\bar{X}$	Rank	S.D.
1	33	0.0364	7	2.61
2	27	-1.0819	4	3.07
3	30	0.6500	8	2.48
4	26	2.7849	10	2.93
5	24	-0.2368	5	4.28
6	30	-3.6964	1	3.25
7	23	-1.6383	3	3.84
8	24	1.7525	9	3.13
9	31	-1.8241	2	3.15
10	31	-1.2328	6	3.52

Table 3-28a

Analysis of Variance of ETS-II Residual Scores for Classes in Standard-Accelerated Program at the End of Grade Seven.

Source of Variance	Sum of Squares	d.f.	Est. Mean Square	F
Among Means	869.59	9	96.62	9.26 [a]
Within Groups	2806.22	269	10.43	
Total	3675.81	278		

[a] Significant at or beyond the .05 level.

Table 3-29

Means, Ranks and Standard Deviations of ETS-II Residual Scores for Classes in the SMSG-Normal Program at the End of Grade Seven.

Class	N	$\bar{X}$	Rank	S.D.
1	30	1.1308	6	4.53
2	24	-2.5891	1	3.20
3	30	-0.1782	3	3.20
4	24	0.9610	5	4.06
5	23	1.4503	8	3.44
6	24	1.1369	7	3.21
7	30	-0.2140	2	3.34
8	28	0.3783	4	4.19

Table 3-29a

Analysis of Variance of ETS-II Residual Scores for Classes in the SMSG-Normal Program at the End of Grade Seven.

Source of Variance	Sum of Squares	d.f.	Est. Mean Square	F
Among Means	321.18	7	45.88	3.36[a]
Within Groups	2801.12	205	13.66	
Total	3122.30	212		

a Significant at or beyond the .05 level.

Table 3-30

Means, Ranks and Standard Deviations of ETS-II Residual Scores for Classes in the SMSG-Accelerated Programs at the End of Grade Seven.

Class	N	$\bar{X}$	Rank	S.D.
1	27	1.9509	4	3.01
2	31	1.2478	1	3.19
3	26	3.7497	6	3.08
4	28	1.5881	3	3.44
5	22	3.0293	5	2.99
6	31	1.4437	2	3.39

Table 3-31

Means, Ranks and Standard Deviations of ETS-II Residual Scores for Classes in the UICSM-8 Program at the End of Grade Seven.

Class	N	$\bar{X}$	Rank	S.D.
1	29	0.1030	3	3.21
2	23	-0.5942	2	3.07
3	24	2.0933	5	3.26
4	27	-0.9635	1	2.28
5	25	4.6831	7	4.28
6	26	6.1762	8	4.00
7	29	2.3040	6	2.95
8	29	0.4823	4	3.07

Table 3-30 + 31 a

Analysis of Variance of ETS-II Residual Scores for Classes in the SMSG-Accelerated and UICSM-8 Programs at the End of Grade Seven.

Source of Variance	Sum of Squares	d.f.	Est. Mean Square	F
Among Means	1330.58	13	102.35	9.59 [a]
Within Groups	3873.65	363	10.67	
Total	5204.23	376		

[a] Significant at or beyond the .05 level

Table 3-31

Means, Ranks and Standard Deviations of ETS-II Residual Scores for Classes in the UICSM-7 Program at the End of Grade Seven.

Class	N	$\bar{X}$	Rank	S.D.
1	28	-0.5382	2	1.99
2	29	-0.4687	3	3.18
3	25	-0.5922	1	2.42
4	31	0.0279	4	2.52
5	30	2.2855	5	3.13

Table 3-31a

Analysis of Variance of ETS-II Residual Scores for Classes in the UICSM-7 Program at the End of Grade Seven.

Source of Variance	Sum of Squares	d.f.	Est. Mean Square	F
Among Means	175.27	4	43.82	5.77 [a]
Within Groups	1145.61	138	8.33	
Total	1320.88	142		

[a] Significant at or beyond the .05 level.

Table 3-32

Rank Order Correlations Between Raw and Residual Score Means on ETS-I and ETS-II for Classes in Each of the Six Mathematics Programs at the End of Grade Seven

	Tests					
	ETS-I			ETS-II		
Programs	N	Σd^2	R	N	Σd^2	R
1. Standard Enriched	14	422	.07	14	326	.29
2. Standard Accelerated	10	47.50	.71	10	32	.81
3. SMSG-Normal	8	6	.93	8	56	.33
4. SMSG-Accelerated	6	6	.83	6	8	.77
5. UICSM-8	8	8	.90	8	4	.95
6. UICSM-7	5	8	.60	5	2	.90

It would appear that in some programs, class status was more dependent upon initial pupil ability than upon the teaching received, while in other programs, classes maintained their status even after initial pupil differences were controlled by regression. The average correlation was approximately equal on the two tests. However, the SMSG-Normal program, which showed little change of class status after regression of the Developed Mathematical Abilities scores (R = .93) showed considerable change of class rank on the Mathematics Achievement Test (R = .33). For both tests, rank order correlations were lowest for the Standard Enriched classes in which there was as much as 11 ranks change (out of 14 classes) on ETS-I and several changes of 7 or more ranks on ETS-II.

Relationship Between ETS-I and ETS-II Class Means. The magnitude of the rank order correlations between ETS-I and ETS-II on both raw and residual class means differed considerably from one program to another. In the

SMSG-Normal program classes generally retained the same position on both tests, even after regression. In Standard Accelerated and UICSM-7, on the other hand, classes shifted position from one test to the other on both raw and residual scores. The expectation that inter-test correlations would decrease substantially when scores were controlled for pupil ability and attitudes was not fulfilled. The mean of the rank order correlations did not differ appreciably from the raw to the residual scores.

Table 3-33

Rank Order Correlations Between ETS-I and ETS-II Raw and Residual Class Means at the End of Grade Seven.

	Scores					
	Raw			Residual		
Program	N	Σd^2	R	N	Σd^2	R
1. Standard Enriched	14	72	.84	14	122	.73
2. Standard Accelerated	10	92.5	.44	10	54	.67
3. SMSG-Normal	8	8	.95	8	2	.98
4. SMSG-Accelerated	6	4	.89	6	8	.77
5. UICSM-8	8	6	.83	8	2	.98
6. UICSM-7	5	8	.60	5	10	.50

Teacher-Made Tests. Near the end of the school year the teachers in each of the five programs (SMSG-Accelerated and UICSM-8 were combined for purposes of program and in-service work with teachers) analyzed the content covered to-date by their classes as well as the material yet to be covered before the end of the year. Each of the topics was given an approximate weight on the basis of time spent and importance of the material for more advanced work. Each of the teachers then submitted items to cover the several topics. The program consultant then selected items according to the number agreed upon for each topic. All programs except Standard Enriched had a two-part test of 30 items each, of which pupils had to answer 25 on each part. The Standard Enriched pupils had a one-part, 34 item test of which they had to answer 25 questions. For purposes of scoring, the two halves were averaged and each pupil received a single score. Regression analyses were performed on each half of the TMT's and the residuals averaged to obtain pupil residual scores.

Raw Scores. Although all teachers took an equal part in the construction of the TMT's, classes within programs varied considerably both in mean score and in the spread of scores within classes. The greatest variability among class means was observed in the Standard Enriched Program which had the smallest within-class variance. The smallest among-class variance was observed in the Standard Accelerated Program. Analyses of variance yeilded significant F ratios for each program. (See Tables 3-34 - 3-39 and 3-34a - 39a.)

The class means ranged from 15.75 to 22.42 in the Standard Enriched Program from 14.96 to 19.54 in Standard Accelerated; from 15.30 to 19.13 in SMSG-Normal, from 16.68 to 21.78 in SMSG-Accelerated; from 14.74 to 19.65 in UICSM-8 and from 14.24 to 17.77 in UICSM-7.

The tests, apparently, varied in difficulty. For the Standard Enriched, SMSG-Accelerated and UICSM-8 classes the grand mean was between 18 and 19+ points, for the Standard Accelerated and UICSM-7 classes it was between 16 and 17 points.

Residual Scores. Regression of scores on pupil abilities and attitudes tended to decrease the variability of individual scores, as expected, as well as the inter-class variability in all programs. (See Tables 3-40 - 3-45) However, analyses of variance yeilded significant F ratios for all programs except SMSG-Normal. Even when individual ability and attitude differences were

Table 3-34

Means, Ranks and Standard Deviations of IMT Raw Scores
for Classes in the Standard Enriched Program
at the End of Grade Seven.

Class	N	Mean	Rank	S.D.
1	26	22.42	14	2.25
2	31	19.26	9	3.21
3	36	17.67	4	3.35
4	33	21.09	11	2.61
5	42	18.74	8	4.08
6	44	19.61	10	2.99
7	42	18.59	7	3.34
8	31	17.48	3	3.67
9	37	17.81	5	3.56
10	28	21.39	12	2.25
11	24	21.42	13	2.53
12	27	18.04	6	2.87
13	32	16.69	2	3.74
14	32	15.75	1	4.66

Table 3-34a

Analysis of Variance of IMT Raw Scores
for Classes in the Standard Enriched Program
at the End of Grade Seven.

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	1493.48	13	114.88	10.27 [a]
Within Groups	5043.48	451	11.88	
TOTAL	6536.96	464		

[a] Significant at or beyond the .05 level.

Table 3-35

Means, Ranks and Standard Deviations of TMT Raw Scores for Classes in the Standard Accelerated Program at the End of Grade Seven.

Class	N	Mean	Rank	S.D.
1	33	16.54	4	3.18
2	27	17.00	6	3.62
3	30	15.77	3	3.92
4	30	17.83	9	3.39
5	26	15.65	2	4.65
6	24	19.54	10	3.16
7	30	16.67	5	3.68
8	23	14.96	1	4.40
9	24	17.75	8	2.51
10	32	17.19	7	3.17

Table 3-35a
Analysis of Variance of TMT Raw Scores for Classes in the Standard Accelerated Program at the End of Grade Seven.

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	385.30	9	42.81	3.30 [a]
Within Groups	3488.56	269	12.97	
TOTAL	3873.86	278		

[a] Significant at or beyond the .05 level.

Table 3-36

Means, Ranks and Standard Deviations of TMT Raw Scores
for Classes in the SMSG-Normal Program
at the End of Grade Seven.

Class	N	Mean	Rank	S.D.
1	30	17.17	3	3.67
2	24	15.96	2	3.54
3	30	15.30	1	3.80
4	24	18.71	7	3.14
5	23	19.13	8	2.78
6	24	18.04	4	3.82
7	30	18.23	5	3.59
8	28	18.25	6	4.71

Table 3-36a

Analysis of Variance of TMT Raw Scores
for Classes in the SMSG-Normal Program
at the End of Grade Seven.

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	340.26	7	48.61	3.56 [a]
Within Groups	2802.57	205	13.67	
TOTAL	3142.83	212		

[a] Significant at or beyond the .05 level.

Table 3-37

Means, Ranks and Standard Deviations of TMT Raw Scores for Classes in the SMSG-Accelerated Program at the End of Grade Seven

Class	N	Mean	Rank	S.D.
1	27	21.78	6	2.12
2	31	17.97	2	3.54
3	26	21.23	5	2.50
4	28	19.75	4	3.23
5	22	18.32	3	3.92
6	31	16.68	1	5.23

Table 3-37a

Analysis of Variance of TMT Raw Scores for Classes in the SMSG-Accelerated Program at the End of Grade Seven

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	556.53	5	111.30	8.53 [a]
Within Groups	2075.05	159	13.05	
TOTAL	2631.58	164		

[a] Significant at or beyond the .05 level.

Table 3-38

Means, Ranks and Standard Deviations of TMT Raw Scores for Classes in the UICSM-8 Program at the End of Grade Seven.

Class	N	Mean	Rank	S.D.
1	29	18.45	6	3.90
2	23	14.74	1	3.54
3	24	20.71	7	1.76
4	27	18.44	5	3.00
5	25	18.32	4	3.84
6	26	19.65	8	3.64
7	29	18.21	3	3.23
8	29	17.45	2	3.90

Table 3-38a

Analysis of Variance of TMT Raw Scores fof Classes in the UICSM-8 Program at the End of Grade Seven.

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	500.72	7	71.53	6.05 [a]
Within Groups	2412.49	204	11.82	
TOTAL	2913.21	211		

[a] Significant at or beyond the .05 level.

Table 3-39

Means, Ranks and Standard Deviations of TMT Raw Scores
for Classes in the UICSM-7 Program
at the End of Grade Seven.

Class	N	Mean	Rank	S.D.
1	28	15.32	2	3.80
2	29	14.24	1	4.18
3	25	17.20	4	2.86
4	31	17.77	5	3.28
5	30	16.87	3	3.53

Table 3-39a

Analysis of Variance of TMT Raw Scores
for Classes in the UICSM-7 Program
at the End of Grade Seven.

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	246.94	4	61.73	4.84 [a]
Within Groups	1760.30	138	12.75	
TOTAL	2007.24	142		

[a] Significant at or beyond the .05 level.

Table 3-40

Means, Ranks and Standard Deviations of TMT Residual Scores
for Classes in the Standard Enriched Program
at the End of Grade Seven.

Class	N	Mean	Rank	S.D.
1	26	3.34	14	2.92
2	31	-.15	8	2.38
3	36	-.58	4	2.98
4	33	-.25	6	3.59
5	42	1.45	12	2.20
6	44	-.22	7	4.46
7	42	-.27	5	3.03
8	31	.69	10	2.28
9	37	.35	9	2.74
10	28	1.16	11	1.60
11	24	1.96	13	2.58
12	27	-.91	3	2.58
13	32	-1.35	2	3.83
14	32	-1.45	1	4.19

Table 3-40a

Analysis of Variance of TMT Residual Scores
for Classes in the Standard Enriched Program
at the End of Grade Seven.

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	678.14	13	52.16	5.40 [a]
Within Groups	4359.79	451	9.67	
TOTAL	5037.93	464		

[a] Significant at or beyond the .05 level.

Table 3-41

Means, Ranks and Standard Deviations of TMT Residual Scores for Classes in the Standard Accelerated Program at the End of Grade Seven

Class	N	Mean	Rank	S.D.
1	33	-.94	3	2.30
2	27	.03	6	2.55
3	30	-.17	5	2.26
4	30	.52	8	2.26
5	26	.41	7	3.06
6	24	2.29	10	2.46
7	30	-1.02	2	2.48
8	23	-1.72	1	3.08
9	24	1.25	9	2.06
10	32	-.21	4	2.20

Table 3-41a

Analysis of Variance of TMT Residual Scores for Classes in the Standard Accelerated Program at the End of Grade Seven

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	307.34	2	34.15	5.59 [a]
Within Groups	1642.65	269	6.11	
TOTAL	1949.99	278		

[a] Significant at or beyond the .05 level.

Table 3-42

Means, Ranks and Standard Deviations of TMT Residual Scores
for Classes in the SMSG-Normal Program
at the End of Grade Seven

Class	N	Mean	Rank	S.D.
1	30	.52	7	2.87
2	24	-.35	3	2.64
3	30	-.56	1	2.98
4	24	.19	6	2.32
5	23	.69	8	1.85
6	24	.12	5	3.18
7	30	-.37	2	3.03
8	28	-.21	4	3.44

Table 3-42a

Analysis of Variance of TMT Residual Scores
for Classes in the SMSG-Normal Program
at the End of Grade Seven

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	38.05	7	5.43	.67
Within Groups	1674.22	205	8.[illegible]7	
TOTAL	1712.27	212		

Table 3-43

Means, Ranks and Standard Deviations of TMT Residual Scores for Classes in the SMSG-Accelerated Program at the End of Grade Seven

Class	N	Mean	Rank	S.D.
1	27	1.35	6	2.35
2	31	-.40	2	3.91
3	26	1.10	5	2.30
4	28	-1.19	1	2.54
5	22	.24	4	2.99
6	31	.13	3	2.08

Table 3-43a

Analysis of Variance of TMT Residual Scores for Classes in the SMSG-Accelerated Program at the End of Grade Seven

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	122.35	5	24.47	3.17 [a]
Within Groups	1227.21	159	7.72	
TOTAL	1349.56	164		

[a] Significant at or beyond the .05 level.

Table 3-44

Means, Ranks and Standard Deviations of TMT Residual Scores
for Classes in the UICSM-8 Program
at the End of Grade Seven.

Class	N	Mean	Rank	S.D.
1	29	.36	5	2.45
2	23	-1.79	1	2.24
3	24	1.95	8	1.85
4	27	-.76	2	1.95
5	25	.31	4	3.03
6	26	1.20	7	2.94
7	29	.41	6	2.30
8	29	-.64	3	1.54

Table 3-44a

Analysis of Variance of TMT Residual Scores
for Classes in the UICSM-8 Program
at the End of Grade Seven.

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	237.55	7	33.93	6.25 [a]
Within Groups	1108.12	204	5.43	
TOTAL	1345.67	211		

[a] Significant at or beyond the .05 level.

Table 3-45

Means, Ranks and Standard Deviations of TMT Residual Scores
for Classes in the UICSM-7 Program
at the End of Grade Seven.

Class	N	Mean	Rank	S.D.
1	28	-.29	2	2.04
2	29	-2.22	1	2.42
3	25	1.04	5	2.08
4	31	.99	4	2.12
5	30	.62	3	2.66

Table 3-45a

Analysis of Variance of TMT Residual Scores
for Classes in the UICSM-7 Program
at the End of Grade Seven.

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	215.08	4	53.77	10.30 [a]
Within Groups	720.69	138	5.22	
TOTAL	935.77	142		

[a] Significant at or beyond the .05 level.

controlled, classes remained significantly different from each other. (See Tables 3-40a - 3-45a.) Average performance on TMT raw and residual scores by program is presented in Table 3-46.

Table 3-46

Means and Standard Deviations of Teacher-Made Test Raw and Residual Scores for Pupils in Six Mathematics Programs at the End of Grade Seven.

Program	Raw Scores $\bar{X}$	Raw Scores S.D.	Residuals $\bar{X}$	Residuals S.D.
1. Standard Enriched	18.886	3.7534	.196	3.2950
2. Standard Accelerated	16.878	3.7329	-.003	2.6484
3. SMSG-Normal	17.544	3.8502	-.015	2.8419
4. SMSG-Accelerated	19.212	4.0057	.174	2.8686
5. UICSM-8	18.264	3.7157	.131	2.5253
6. UICSM-7	16.286	3.7597	.018	2.5670

Relationship Between Teacher-Made Tests and ETS-II Raw and Residual Scores. Controlling for pupil abilities and attitudes shifted class rank order on the Teacher-Made Tests to varying degrees in the several programs. UICSM-7 was least affected (R=.90), while SMSG-Accelerated showed the greatest effects (R=.60). (See Table 3-47.) The average rank order correlation between Teacher-Made Test raw and residual class ranks for the six programs was .71.

Table 3-47

Rank Order Correlation Between Teacher-Made Test Raw and Residual, Teacher-Made Test Raw and ETS-II Raw and Teacher-Made Test Residual and ETS-II Residual Class Means for Classes in Six Mathematics Programs at the End of Grade Seven.

	Tests						
	TMT Raw TMT Residual			TMT Raw ETS-II Raw		TMT Residual ETS-II Residual	
Program	N	Ed2	R	Ed2	R	Ed2	R
1. Standard Enriched	14	131	.71	103	.77	350	.23
2. Standard Accelerated	10	50	.70	216	-.30	236	-.43
3. SMSG-Normal	8	32	.62	8	.91	14	.83
4. SMSG-Accelerated	6	14	.60	12	.66	12	.66
5. UICSM-8	8	22	.74	36	.57	26	.69
6. UICSM-7	5	2	.90	14	.30	24	-.20

When Teacher-Made Test and ETS-II class ranks were correlated it became clear that particularly for the Standard Accelerated and UICSM-7 programs, the kind of achievement measured by the Mathematics Achievement Test (ETS-II) differed considerably from the content assessed by the Teacher-Made Tests. The negative correlations for both programs on the residual comparison and for Standard Accelerated on the raw comparison as well testify to the great disparity in content between the two tests. For example, Class 6 in the Standard Accelerated program ranked lowest of all ten classes on ETS-II (Raw and Residual) and had the highest raw and residual mean scores on the Teacher-Made Test. Similarly, Class 3 in UICSM-7 ranked lowest of all five classes on ETS-II residual scores and highest on the TMT residuals.

Summary of Within Program Analyses. Even after controlling for initial pupil ability and attitudes toward mathematics, classes within programs continued to differ significantly on the three measures. Although in some programs classes tended to retain their status on all measures, in other programs classes shifted greatly in the rank order from one test to another. The greatest discrepancies in class rank were observed in the UICSM-7 and Standard Accelerated Programs between Teacher-Made Test and ETS-II, both achievement tests. Thus, variables other than the seven included in the multiple regression equation affected pupil attainment and class status. An investigation of the effects of some selected teacher variables was performed by Neill [a] who found that the amount of teacher preparation had a significant positive correlation with class scores on the three criterion measures. However, even after controlling for the teacher's educational attainment (as well as for some other teacher factors) significant class differences still remained. The multiple R^2 (based on the seven independent variables) for each of the 3 tests explained about one-third of the variance in scores. The teacher factors explained an additional 20%. Thus, about 45 percent of the within program variance remained unexplained by any of the factors controlled in this or Neill's study.

Relationship Among the Three Criterion Measures. Product moment correlations between the two ETS measures and between each of them and the Teacher-Made Tests were computed within each of the six programs and for the total population. (See Table 3-48.) For each program and for the total population, the correlations between ETS-I and ETS-II were greater than the correlations between the ETS measures and the Teacher-Made Tests. The magnitude of the correlations, however, varied considerably from one program to another. They were highest

[a] Robert D. Neill. The Effects of Selected Teacher Variables on Mathematics Achievement of Academically Talented Junior High School Pupils. Unpublished doctoral dissertation. Teachers College, Columbia University, 1966.

for UICSM-8, lowest for Standard Accelerated; and, generally, higher for the contemporary programs than for the standard ones. It would appear that the several tests tended to have more in common for the contemporary than for the standard programs and may explain, in part, why the former tended to have higher means on the ETS tests than the latter. (See Tables B-8 and B-8a-B-8f in Appendix B.)

Table 3-48

Intercorrelations Among Three Criterion Variables for Pupils in Each of Six Mathematics Programs and for the Total Population at the End of Grade Seven.

	Correlations		
Program	ETS-I and ETS-II	ETS-I and TMT	ETS-II and TMT
1. Standard Enriched	.54	.36	.40
2. Standard Accelerated	.44	.38	.35
3. SMSG-Normal	.65	.53	.54
4. SMSG-Accelerated	.52	.54	.48
5. UICSM-8	.66	.53	.61
6. UICSM-7	.59	.49	.53
7. Total	.62	.38	.38

CHAPTER IV

End of Grade Eight Results

During the second year of the study (school year 1963-1964) when the pupils were in 8th grade, 49 of the original classes participated. However, pupil mobility both during the summer and during the school year resulted in a loss of 200 pupils or about 13% from the end of seventh grade to the end of eighth grade. By May, 1964, there were 1271 students in the 49 participating classes.

In-Service Program

The in-service program for the teachers continued throughout the school year. Teachers in five of the six programs [a] had a minimum of four sessions with the consultant assigned to that particular program. Teachers in the Standard Accelerated Program met only twice.

End of Year Results.

Testing Program

At the end of Grade 8 each of the participating students took three tests: 1) Teacher Made Test (TMT) developed cooperatively by the teachers and the consultant of each program separately to test the material covered in the

[a] From the beginning of Grade 8 the teachers in the SMSG-Accelerated and the UICSM-8 programs were separated.

particular program. 2) Test of Developed Mathematical Abilities (ETS-I) prepared by the Educational Testing Service to assess general mathematical competence and 3) Test of Mathematics Achievement (ETS-II), also prepared by the Educational Testing Service which combined materials derived from each of the six programs. This test thus consisted of six sub-tests, although the 40 items were randomly distributed through the test.

Analyses of Test Results.

The scores on the two tests which cut across all programs (ETS-I and ETS-II) were subjected to one way analyses of variance both by pupils across programs and by classes within program. The six sub-tests of ETS-II were also analyzed for each program to determine the extent to which pupils in the various courses of study could handle both the material they had ostensibly been taught as well as material to which they had not been directly exposed.

To insure relative comparability of the groups in the several programs, all test scores were again, as at the end of Grade 7, controlled for the seven initial independent variables (IQ, Reading, Arithmetic, SES, Attitudes toward Math, Assessment of Own Math Ability, General Self-Assessment) by a series of regression equations.[a] (See Tables C-1, C-2, C-3 in Appendix C.) All analyses were performed on both raw and residual scores.

Cross Program Analyses

Developed Mathematical Abilities Test (ETS-I). Table 4-1 presents the means and standard deviations for both raw and residual scores for each program

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[a] For the two ETS Tests, the regression equations were derived from the total population. For TMT's regression was based on each program separately, since all analyses were within program.

Table 4-1

Means, Standard Deviations and Ranges of the Raw and Residual Scores on the Developed Mathematical Abilities Test (ETS-I) At End of Grade Eight

Program	N	Raw Scores Mean	Raw Scores S.D.	Raw Scores Range[a]	Residuals Mean	Residuals S.D.
Standard Enriched	321	15.54	4.51	6-29	-.9341	3.65
Standard Accelerated	248	18.60	4.45	9-28	-.0907	3.78
SMSG-Normal	202	18.31	4.80	5-30	.0555	3.57
SMSG-Accelerated	160	19.58	4.19	9-30	.7075	3.54
UICSM-8	212	19.00	4.43	8-28	.7009	3.83
UICSM-7	128	18.50	4.42	5-28	.3812	3.59
Total	1271	17.95	4.49	5-30	0.0000	3.69

[a] Maximum possible score = 30. Ranges are reported for raw scores only, and present the lowest and highest pupil score for each program.

Table 4-2

Analysis of Variance of Raw Scores on ETS-I for Pupils in Six Mathematics Programs at End of Grade Eight.

Source of Variance	Sum of Squares	d.f.	Est. Mean Squares	F
Among Means	2673.70	5	534.74	26.56 [a]
Within Groups	25488.19	1265	20.13	
TOTAL	28161.89	1270		

Scheffé Tests

	1	2	3	4	5	6
1		-3.0574 [a]	-2.7684 [a]	-4.0378 [a]	-3.4566 [a]	-2.9566 [a]
2						
3						
4						
5						

Enriched vs. Accelerated = -1.9929 [a]

Contemporary vs. Standard = 1.7762 [a]

[a] Significant at or beyond the .05 level.

Table 4-3

Analysis of Variance of Residual Scores on ETS-I
for Pupils in Six Mathematics Programs at
the End of Grade Eight.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	485.70	5	97.14	7.15[a]
Within Groups	17181.77	1265	13.58	
TOTAL	17667.47	1270		

Scheffé Tests

	1	2	3	4	5	6
1				-1.6416[a]	-1.6350[a]	-1.3153[a]
2						
3						
4						
5						

Enriched vs. Accelerated = -.8640[a]

Contemporary vs. Standard = .9737[a]

[a] Significant at or beyond the .05 level.

on the Developed Mathematical Abilities Test. For the raw scores, ranges are presented, as well. A one-way analysis of variance of the raw scores found inter-program differences significant well beyond the .05 level (See Table 4-2). Scheffé comparisons among the several programs found that the pupils in the Standard Enriched program scored significantly (at the .05 level) below the pupils in each of the other programs. When the residual scores were subjected to analysis (See Table 4-3) the results remained significant, but the magnitude of the differences decreased. Scheffé contrasts showed the Standard Enriched program to differ significantly only from the SMSG-Accelerated and the two UICSM programs.

Contrasts (of both raw and residual scores) between enriched and accelerated programs found the latter to be significantly superior. Similarly, contrasts between the "standard" and the "contemporary" programs found that pupils in the "contemporary" programs scored significantly higher. Rank order of raw and residual means changed only for three programs: Standard Accelerated moved from 3rd to 5th place; UICSM-7 from 4th to 3rd and SMSG-Normal from 5th to 4th.

Mathematics Achievement Test (ETS-II). On the Mathematics Achievement Test raw scores tended to be somewhat lower for each group than they were on the Developed Mathematical Abilities Test (ETS-I), even though the former had a higher possible score. (See Table 4-4.) The means (out of a maximum of 40 items) ranged from about 14 for the Standard Enriched to almost 18 for the

Table 4-4

Means, Standard Deviations and Ranges of the Mathematics Achievement Test (ETS-II) Raw and Residual Scores At End of Grade Eight.

		Raw Scores			Residuals	
Program	N	Mean	S.D.	Range[a]	Mean	S.D.
Standard Enriched	321	14.06	3.71	7-27	-.5369	3.21
Standard Accelerated	248	14.79	4.00	5-27	-1.5145	3.56
SMSG-Normal	202	15.76	4.42	7-33	-.2052	3.70
SMSG-Accelerated	160	17.23	4.14	8-26	.7966	3.67
UICSM-8	212	17.70	4.33	7-30	1.5716	3.81
UICSM-7	128	16.94	3.86	8-25	1.0151	3.34
Total	1271	15.75	4.05	5-33	0.0000	3.54

[a] Maximum possible score = 40. Ranges are reported for raw scores only, and represent the lowest and highest pupil score in each program.

Table 4-5

Analysis of Variance of Raw Scores on *ETS-II* for Pupils in Six Mathematics Programs at the End of Grade Eight.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	2420.04	5	484.01	29.54[a]
Within Groups	20745.95	1265	16.39	
TOTAL	23165.99	1270		

Scheffé Tests

	1	2	3	4	5	6
1			-1.7002[a]	-3.1691[a]	-3.6368[a]	-2.8794[a]
2				-2.4369[a]	-2.9046[a]	-2.1472[a]
3				-1.4689[a]	-1.9366	
4						
5						
6						

Enriched vs. Accelerated = -1.7543[a]
Contemporary vs. Standard = 2.4803[a]

[a] Significant at or beyond the .05 level.

Table 4-6

Analysis of Variance of Residual Scores on ETS-II for Pupils in Six Mathematics Programs at the End of Grade Eight.

Source of Variance	Sum of Squares	d.f.	Est. Mean Squares	F
Among Means	1427.01	5	285.40	22.83[a]
Within Groups	15816.40	1265	12.50	
TOTAL	17243.41	1270		

Scheffé Tests

	1	2	3	4	5	6
1				-1.3335[a]	-2.1085[a]	-1.5520[a]
2			-1.3093[a]	-2.3111[a]	-3.0861[a]	-2.5296[a]
3					-1.7768[a]	
4				-		
5					-	

Enriched vs. Accelerated = -.8383[a]

Contemporary vs. Standard = 1.8202[a]

[a] Significant at or beyond the .05 level.

UICSM-8 group. A one-way analysis of variance showed significant differences among group means (See Table 4-5). Scheffé contrasts found that pupils in the Standard Enriched classes performed less well than pupils in all other programs except the Standard Accelerated, which was significantly lower than the three accelerated modern programs (SMSG-Accelerated, UICSM-8 and UICSM-7). The SMSG-Normal program fell significantly below the SMSG-Accelerated and UICSM-8. As on ETS-I, pupils in the accelrated programs scored higher than those in the enriched; and the contemporary programs exceeded the standard ones.

The analysis of residuals also yielded a significant F ratio, and the accelerated and contemporary programs remained superior to the enriched and standard ones. (See Table 4-6.). However, contrasts among programs no longer found the Standard Accelerated superior to the Standard Enriched or the SMSG-Accelerated to the SMSG-Normal; the latter, however, scored significantly higher than the Standard Accelerated.

The rank order of the six programs was not consistent in the raw and residual analyses. Although UICSM-8 held the first position in both rank orders, SMSG-Accelerated moved from second to third place while UICSM-7 moved from third to second. Standard Enriched changed places with Standard Accelerated, moving from 6th to 5th place. SMSG-Normal retained 4th place. (See Tables C-6a to C-6f, Appendix C, for summaries of ETS-I and ETS-II scores by program.

Sub-test Analyses - ETS-II - Raw Scores. Since the Mathematics Achievement Test was made up of six sub-tests, each composed of items drawn from the material specifically taught in each of the six programs, pupils could be compared on their ability to cope with content to which they had not been directly exposed as well as to material from their own course of study. Table 4-7 presents the raw score means, ranks and standard deviations for each program on each sub-test and Table 4-8 presents the same data for the residual scores.

One-way analyses of variance for the six programs on the raw scores of each sub-test found significant *F* ratios for all six sub-tests. (See Tables C-4a to C-4f in Appendix C.) However, the groups showed little consistency in regard to "own" versus "others" sub-tests.

On sub-test I, SMSG-Normal did significantly better than Standard Enriched from whose course of study the sub-test was constructed. In fact, the Standard Enriched program ranked 5th on its own sub-test. Differences between the Enriched and Accelerated or the Standard and Contemporary were not significant.

On its "own" sub-test II, the Standard Accelerated pupils ranked second, and differed significantly from the Standard Enriched and both UICSM programs. Pupils in the first ranking SMSG-Accelerated program apparently dealt with the advanced traditional algebraic material taught in the Standard Accelerated program even better than did the traditional accelerants themselves.

Table 4-7.

Means, Ranks and Standard Deviations of Raw Scores on the Six Sub-Tests of ETS-II for Each of the Six Mathematics Programs at the End of Grade Eight.

Program	Sub-Tests I[a]			II[b]			III[a]			IV[b]			V[b]			VI[a]			
	$\bar{X}$	Rank	S.D.	$\bar{X}$	Rank	S.D.	$\bar{X}$	Rank	S.D.	$\bar{X}$	Rank	S.D.	$\bar{X}$	Rank	S.D.	$\bar{X}$	Rank	S.D.	Σ Ranks
St. Enrich.	2.11[c]	2	1.27	1.41	2	0.85	2.53	1	1.12	1.89	2	1.13	1.90	2	1.13	4.26	2	1.39	11
St. Accel.	2.16	4	1.23	1.80[c]	5	1.02	2.74	2.5	1.15	1.83	1	1.13	2.09	3	1.11	4.10	1	1.49	16.5
SMSG-Normal	2.49	6	1.27	1.60	4	0.88	3.14[c]	6	1.22	2.27	3	1.35	1.80	1	1.04	4.44	3	1.54	23
SMSG-Accel.	2.38	5	1.18	1.83	6	1.10	2.74	2.5	1.17	2.85[c]	4	1.35	2.23	4	1.06	5.26	4	1.45	25.5
UICSM-8	2.12	3	1.24	1.49	3	0.87	2.95	5	1.29	3.04	6	1.32	2.29[c]	5	1.05	5.67	6	1.48	28
UICSM-7	2.07	1	1.16	1.28	1	0.92	2.86	4	1.21	2.89	5	1.24	2.46	6	1.11	5.46[c]	5	1.47	22

[a] Maximum score = 7

[b] Maximum score = 6

[c] Sub-test composed of material taught in the particular program.

On its "own" sub-test III, the SMSG-Normal program ranked first and did significantly better than either of the standard programs, but not significantly better than the other contemporary programs.

On sub-test IV, derived from SMSG-Accelerated content, the two UICSM programs ranked in first and second place, but did not score significantly higher than the third place SMSG-Accelerated. On this sub-test, each of the "modern" programs exceeded the two traditional ones and accelerated programs, in aggregate, had significantly higher means than the two enriched ones.

On its "own" sub-test V, UICSM-8 ranked second, UICSM-7 ranked first. However, the three accelerated modern programs did not differ from each other, but each of the three differed significantly from the modern enriched program (SMSG-Normal). In general, the accelerated programs scored significantly higher than the enriched ones. Differences between contemporary and standard were not significant.

On sub-test VI, built around the UICSM-7 content, UICSM-8 ranked first, and UICSM-7, second. These two programs, as well as the SMSG-Accelerated had significantly higher means than the two standard and the one contemporary enriched program, but they did not differ significantly from each other.

<u>Summary</u>. On the basis of the raw score analyses, the SMSG-Normal program was the only one to rank first on its own sub-test. However, with the exception of Standard Enriched, which ranked fifth on its own sub-test, each of the other programs ranked in the top half of the rank order on the material supposedly derived from their own courses of study. It also appeared that some of the sub-tests were intrinsically more difficult than others. For example the means on the seven-item sub-test VI were about double the means on the seven-item sub-tests I and III. Similarly, the means on the six-item subtest IV were generally higher than the means on sub-test II which had the same number of items.

Sub-test Analyses - ETS-II - Residuals. When the scores of each of the sub-tests were regressed on the seven pupil characteristics, (See Table C-2, Appendix C) the rank order of the residual means by program differed somewhat from the rank order observed in the raw score analyses. (See Table 4-8.) For sub-tests IV and V (SMSG-Accelerated and UICSM-8, respectively) the order remained completely unchanged. For sub-tests II and VI the rank order correlation was .94; on sub-test II, R=.81 and for sub-test I, which showed the greatest amount of shift after regression, R=.60.

The only program which ranked highest on its "own" sub-test was SMSG-Normal. Standard Accelerated, UICSM-8 and UICSM-7 each held second position on their "own" sub-tests (a rank of 5). However, inspection of the rows of Table 4-8 indicates that all programs except UICSM-8 received their highest residual scores on their "own" sub-tests. UICSM-8 pupils did better on both the Standard Accelerated and the UICSM-7 material than they did on their own. The sum of ranks across rows placed UICSM-8 in first place, Standard Accelerated in last place.

One-way analyses of variance of the six sub-test residual scores all yielded significant F ratios (See Tables C-5a - C-5f, Appendix C.). On its "own" sub-test I, Standard Enriched held third place, SMSG-Normal pupils scored highest while Standard Accelerated and both UICSM programs scored below expectation. Scheffe contrasts found Standard Accelerated significantly below SMSG-Normal. Neither of the cluster contrasts reached significance.

On its "own" sub-test II, Standard Accelerated held second place, exceeded by SMSG-Accelerated. The two UICSM programs and Standard Enriched fell more or less below expectation and the differences between UICSM-7 and both Standard

Accelerated and SMSG-Accelerated reached significance. The enriched programs fell significantly below the accelerated but the contemporary did not differ significantly from the standard ones.

On its "own" sub-test III, SMSG-Normal ranked highest and pupils in this program did significantly better than those in the two standard and in the SMSG-Accelerated programs. In addition, Standard Accelerated fell significantly below Standard Enriched and both UICSM programs. The contemporary cluster exceeded the standard one, but the enriched and accelerated clusters did not differ significantly from each other.

On sub-test IV, based on the SMSG-Accelerated course of study, UICSM-8 ranked highest, UICSM-7 second and SMSG-Accelerated, third. Pupils in each of the contemporary accelerated programs scored significantly higher than pupils in either standard program or in SMSG-Normal; and Standard Accelerated fell significantly below the other two. Despite the poor showing of Standard Accelerated, the accelerated cluster did significantly better than the enriched. The contemporary programs combined exceeded the standard ones.

On the UICSM-8 sub-test V, UICSM-7 ranked highest, followed by UICSM-8 and SMSG-Accelerated; but the differences among these three were not significant. Only UICSM-7 differed significantly from each of the Standard programs and both UICSM programs were significantly above SMSG-Normal. Of the two cluster contrasts, only the difference between enriched and accelerated reached a significant level.

On the UICSM-7 sub-test VI, UICSM-8 pupils scored highest, although they did not differ significantly from UICSM-7 pupils. They did, however, score significantly higher than the pupils in the other four programs. UICSM-7 had a significantly higher mean than the two standard and the SMSG-Normal programs

Table 4-8

Means, Ranks and Standard Deviations of Residual Scores on the Six Sub-tests of ETS-II for Each of the Six Mathematics Programs at the End of Grade Eight.

		Sub-tests																	
		I			II			III			IV			V			VI		
Program	N	$\bar{X}$	Rank	S.D.	$\bar{X}$	Rank	S.D.	$\bar{X}$	Rank	S.D.	$\bar{X}$	Rank	S.D.	$\bar{X}$	Rank	S.D.	$\bar{X}$	Rank	S.D.	Σ Ranks
St.Enrich.	321	0.04 $\sqrt{}$[a]	4	1.22	-0.02	3	0.85	-0.07	3	1.05	-0.22	2	1.10	-0.05	2	1.12	-0.20	3	1.19	17
St.Accel.	248	-0.14	1	1.19	0.13 $\sqrt{}$[a]	5	0.95	-0.41	1	1.09	-0.63	1	0.95	-0.06	3	1.09	-0.74	1	1.45	12
SMSG-Nor.	202	0.25	6	1.17	0.01	4	0.82	0.30 $\sqrt{}$[a]	6	1.17	-0.12	3	1.21	-0.30	1	1.02	-0.35	2	1.48	22
SMSG-Accel.	160	0.06	5	1.09	0.17	6	1.05	-0.17	2	1.09	0.37 $\sqrt{}$[a]	4	1.27	0.07	4	1.04	0.20	4	0.96	25
UICSM-8	212	-0.09	3	1.15	-0.11	2	0.83	0.10	5	1.22	0.62	6	1.27	0.17 $\sqrt{}$[a]	5	1.01	0.87	6	1.46	27
UICSM-7	128	-0.13	2	1.14	-0.30	1	0.87	0.03	4	1.20	0.43	5	1.23	0.36	6	1.05	0.63 $\sqrt{}$[a]	5	1.44	23

[a] $\sqrt{}$ Sub-test composed of material taught in the particular program.

and SMSG-Accelerated exceeded its normal counterpart as well as Standard Accelerated; the latter was also exceeded by Standard Enriched. When the two sets of program clusters were contrasted, the accelerated and the contemporary programs were significantly higher than the enriched and the standard, respectively.

<u>Summary</u>. When sub-test scores were controlled for pupil ability and attitude, the results were even less consistent with the theory on which the test was constructed than was true for the raw score comparisons. Only SMSG-Normal did better on material ostensibly derived from its own course of study than did the other programs. However, except for the UICSM-8 pupils, who achieved their highest mean score on the UICSM-7 subtest, all other programs ranked higher on their own sub-test than on any other one. Both standard programs fell below their predicted scores on all sub-tests, save their own; SMSG-Normal did somewhat better than predicted on the standard content, less well on the contemporary content; SMSG-Accelerated fell below its predicted mean score only on the SMSG-Normal sub-test and UICSM-8, only on the Standard Accelerated sub-test. UICSM-7 scored above the predicted level on all four contemporary sub-tests, below on the two standard ones.

Analyses of variance across programs yielded significant <u>F</u> ratios for each sub-test. Significant contrasts among programs were most frequent on sub-tests IV (SMSG-Accelerated) and VI(UICSM-7) (eleven and ten, respectively, out of a possible 15) and least frequent on sub-tests I (Standard Enriched) and Sub-test II (Standard Accelerated) (one and two, respectively, out of a possible 15).

Within Program Analyses

ETS-I. - Raw Scores. Inspection of the raw score classroom means revealed considerable differences among classes in each of the programs. (See Tables 4-9 through 4-14). The range of class means was greatest in the Standard Enriched and the SMSG-Normal programs (about 7.5 score points), least in the SMSG-Accelerated and UICSM-7 programs (about 4 points). However, all the one-way analyses of variance across classes within each program yielded significant F ratios (See Tables 4-9a through 4-14a). After inspection it appeared that the range of classroom means within most of the programs was as great or greater than the range across programs. The average difference between highest and lowest class mean within programs was about 6 points, whereas the difference between highest and lowest program means was only about 4 points.

ETS-I - Residual Scores. However, after performing a regression analysis and treating the residual scores, the intra-program variability was considerably reduced. (See Tables 4-15 to 4-20). Although in some of the programs (Standard Accelerated, SMSG-Normal and UICSM-7) inter-class differences still reached significance, in the remaining programs, no significant differences remained. (See Tables 4-15a - 4-20a.) Thus, much of the within program classroom variability noted in the raw score analyses was a function of differences in pupil abilities and attitudes. Nevertheless, some of the variability could not be attributed to pupil differences and may, as was the case in Grade 7, reflect, among other variables, differences in teacher preparation and teacher sex.

Table 4-9

Means, Ranks and Standard Deviations of ETS-I Raw Scores for Classes in the Standard Enriched Program at the End of Grade Eight.

Class	Mean	Rank	S.D.
1	16.88	9	4.12
2	15.31	4	4.62
3	16.70	7	3.88
4	9.53	1	2.72
5	14.18	2	3.95
6	17.07	12	4.58
7	16.93	10	4.15
8	16.96	11	4.58
9	16.74	8	4.84
10	15.59	6	3.84
11	15.52	5	3.30
12	14.86	3	4.00
Total	15.60	--	4.13

Table 4-9a.

Analysis of Variance of Raw Scores on ETS-I for Classes in the Standard Enriched Program at the End of Grade Eight.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	867.74	11	78.89	4.63[a]
Within Groups	5285.58	309	17.05	
Total	6153.32	320		

[a] Significant at or beyond the .05 level.

Table 4-10

Means, Ranks and Standard Deviations of ETS-I Raw Scores for Classes in the Standard Accelerated Program at the End of Grade Eight.

Class	Mean	Rank	S.D.
1	17.88	4	4.29
2	18.20	5	4.16
3	17.61	3	4.24
4	23.32	10	4.33
5	16.65	2	3.82
6	18.86	7	3.87
7	18.77	6	4.97
8	16.55	1	4.07
9	19.10	8	4.21
10	19.17	9	3.56
Total	18.60	--	4.12

Table 4-10a

Analysis of Variance of Raw Scores on ETS-I for Classes in the Standard Accelerated Program at the End of Grade Eight.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	847.81	9	94.20	5.55 [a]
Within Groups	4023.51	238	16.98	
Total	4871.32	247		

[a] Significant at or beyond the .05 level.

Table 4-11

Means, Ranks and Standard Deviations of ETS-I Raw Scores for Classes in the SMSG-Normal Program at the End of Grade Eight.

Class	Mean	Rank	S.D.
1	18.53	4	4.79
2	13.83	1	4.08
3	15.93	2	4.51
4	18.69	5	2.85
5	18.96	6	3.88
6	18.20	3	4.63
7	21.10	7	3.71
8	21.41	8	4.36
Total	18.43	-	4.20

Table 4-11a

Analysis of Variance of Raw Scores on ETS-I for Classes in the SMSG-Normal Program at the End of Grade Eight.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	1139.41	7	162.77	9.23[a]
Within Groups	3421.97	194	17.64	
Total	4561.38	201		

[a] Significant at or beyond the .05 level.

Table 4-12

Means, Ranks, and Standard Deviations of ETS-I Raw Scores for Classes in the SMSG-Accelerated Program at the End of Grade Eight.

Class	Mean	Rank	S.D.
1	20.65	4	3.55
2	17.17	1	3.89
3	20.96	6	4.71
4	20.85	5	4.14
5	19.48	3	3.40
6	19.03	2	4.24
Total	19.48	-	4.01

Table 4-12a

Analysis of Variance of Raw Scores on ETS-I for Classes in the SMSG-Accelerated Program at the End of Grade Eight.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	685.32	5	137.06	8.51 [a]
Within Groups	2480.63	154	16.11	
Total	3165.95	159		

[a] Significant at or beyond the .05 level.

Table 4-13

Means, Ranks, and Standard Deviations of ETS-I Raw Scores for Classes in the UICSM-8 Program at the End of Grade Eight.

Class	Mean	Rank	S.D.
1	18.85	5	4.34
2	15.04	1	2.98
3	21.60	8	3.44
4	18.19	2	4.09
5	20.43	7	4.66
6	18.65	3	4.57
7	18.78	4	3.70
8	19.31	6	4.28
Total	18.85	-	4.08

Table 4-13a

Analysis of Variance of Raw Scores on ETS-I for Classes in the UICSM-8 Program at the End of Grade Eight.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	572.82	7	81.83	4.92 [a]
Within Means	3373.62	204	16.62	
Total	3946.44	211		

[a] Significant at or beyond the .05 level.

Table 4-14

Means, Ranks and Standard Deviations of ETS-I Raw Scores for Classes in the UICSM-7 Program at the End of Grade Eight.

Class	Mean	Rank	S.D.
1	18.91	4	4.25
2	18.63	3	4.36
3	16.75	1	4.00
4	20.76	5	4.61
5	17.44	2	4.10
Total	18.56	-	4.28

Table 4-14a

Analysis of Variance of Raw Scores on ETS-I for Classes in the UICSM-7 Program at the End of Grade Eight.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	255.38	4	63.84	3.48 [a]
Within Groups	2235.93	123	18.33	
Total	2491.31	127		

[a] Significant at or beyond .05 level.

Table 4-15

Means, Ranks and Standard Deviations of ETS-I Residual Scores for Classes in the Standard Enriched Program at the End of Grade Eight.

Class	Mean	Rank	S.D.
1	0.16	10	3.79
2	-1.76	2	3.28
3	-0.43	9	4.45
4	-1.24	5.5	5.17
5	-2.14	1	3.05
6	0.38	11	3.55
7	0.44	12	3.60
8	-0.92	8	3.07
9	-1.45	4	3.82
10	-1.72	3	3.36
11	-1.04	7	3.66
12	-1.24	5.5	3.35
Total	-0.93	-	3.61

Table 4-15a

Analysis of Variance of Residual Scores on ETS-I for Classes in the Standard Enriched Program at the End of Grade Eight.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	245.12	11	22.28	1.71
Within Groups	4027.18	309	13.03	
Total	4272.30	320		

Table 4-16

Means, Ranks and Standard Deviations of ETS-I Residual Scores for Classes in the Standard Accelerated Program at the End of Grade Eight.

Class	Mean	Rank	S.D.
1	-0.90	1	4.09
2	-0.14	6	3.19
3	-0.51	5	2.96
4	3.21	10	3.06
5	-0.64	4	5.12
6	-0.88	2	3.67
7	-0.71	3	4.69
8	0.06	9	2.70
9	-0.05	7.5	3.45
10	-0.05	7.5	3.46
Total	-0.09	-	3.69

Table 4-16a.

Analysis of Variance of Residual Scores on ETS-I for Classes in the Standard Accelerated Program at the End of Grade Eight.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	292.30	9	32.48	2.38 [a]
Within Groups	3244.43	238	13.63	
Total	3536.77	247		

[a] Significant at or beyond the .05 level.

Table 4-17

Means, Ranks and Standard Deviations of ETS-I Residual Scores for Classes in the SMSG-Normal Program at the End of Grade Eight.

Class	Mean	Rank	S.D.
1	0.70	7	3.82
2	-1.32	2	3.53
3	-1.98	1	3.75
4	0.66	6	2.96
5	0.26	3	2.74
6	0.29	4	3.59
7	0.61	5	3.35
8	1.31	8	3.52
Total	0.06	-	3.46

Table 4-17a

Analysis of Variance of Residual Scores on ETS-I for Classes in the SMSG-Normal Classes at the End of Grade Eight.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	234.13	7	33.45	2.79 [a]
Within Groups	2327.68	194	12.00	
Total	2561.81	201		

[a] Significant at or beyond the .05 level.

Table 4-18

Means, Ranks and Standard Deviations of ETS-I Residual Scores for Classes in the SMSG-Accelerated Program at the End of Grade Eight.

Class	Mean	Rank	S.D.
1	1.29	4	3.45
2	-0.43	1	3.57
3	1.53	6	4.00
4	0.73	3	3.87
5	1.37	5	1.96
6	0.25	2	3.65
Total	0.71	-	3.52

Table 4-18a

Analysis of Variance of Residual Scores on ETS-I for Classes in the SMSG-Accelerated Program at the End of Grade Eight.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	81.26	5	16.25	1.31
Within Groups	1912.66	154	12.42	
Total	1993.92	159		

Table 4-19

Means, Ranks and Standard Deviations of ETS-I Residual Scores for Classes in the UICSM-8 Program at the End of Grade Eight.

Class	Mean	Rank	S. D.
1	0.31	3	3.41
2	-0.41	1	3.27
3	1.41	6	2.70
4	-0.28	2	3.40
5	1.49	8	5.81
6	0.47	4	3.61
7	1.47	7	4.21
8	1.01	5	3.61
Total	0.70	-	3.88

Table 4-19a

Analysis of Variance of Residual Scores on ETS-I for Classes in the UICSM-8 Program at the End of Grade Eight.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	106.48	7	15.21	1.01
Within Groups	3071.29	204	15.06	
Total	3177.77	211		

Table 4-20

Means, Ranks and Standard Deviations of ETS-I Residual Scores for Classes in the UICSM-7 Program at the End of Grade Eight.

Class	Mean	Rank	S.D.
1	0.86	4	3.56
2	0.09	3	3.68
3	-0.82	1	2.73
4	2.11	5	3.65
5	-0.58	2	3.59
Total	0.38	-	3.47

Table 4-20a

Analysis of Variance of Residual Scores on ETS-I for Classes in the UICSM-7 Program at the End of Grade Eight.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	156.04	4	39.01	3.24 [a]
Within Groups	1483.48	123	12.06	
Total	1639.52	127		

[a] Significant at or beyond the .05 level.

Table 4-21

Means, Ranks and Standard Deviations of ETS-II Raw Scores for Classes in the Standard Enriched Program at End of Grade Eight.

Class	Mean	Rank	S.D.
1	17.16	12	4.43
2	14.43	7	3.68
3	14.50	8	3.44
4	10.73	1	1.94
5	13.11	3	3.29
6	14.53	9	3.98
7	14.87	11	3.60
8	14.00	6	3.72
9	14.74	10	3.38
10	13.74	5	2.94
11	13.36	4	2.80
12	12.86	2	2.70
Total	14.10	--	3.43

Table 4-21a

Analysis of Variance of Raw Scores on ETS-II for Classes in the Standard Enriched Program at End of Grade Eight.

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	545.50	11	49.59	4.23 [a]
Within Groups	3637.32	309	11.73	
TOTAL	4182.82	320		

[a] Significant at or beyond the .05 level

Table 4-22

Means, Ranks and Standard Deviations of ETS-II Raw Scores for Classes in the Standard Accelerated Program at End of Grade Eight

Class	Mean	Rank	S.D.
1	13.75	3	2.98
2	12.12	1	2.82
3	14.07	4	3.62
4	19.09	10	4.44
5	14.13	5	3.64
6	14.57	7	2.86
7	14.36	6	3.05
8	12.27	2	4.37
9	16.83	9	4.13
10	15.30	8	3.60
Total	14.72	--	3.61

Table 4-22a

Analysis of Variance of Raw Scores on ETS-II for Classes in the Standard Accelerated Program at End of Grade Eight

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	917.02	9	101.89	7.83 [a]
Within Groups	3084.70	238	13.02	
TOTAL	4001.72	247		

[a] Significant at or beyond the .05 level

Table 4-23

Means, Ranks and Standard Deviations of ETS-II Raw Scores for Classes in the SMSG - Normal Program at End of Grade Eight.

Class	Mean	Rank	S.D.
1	15.78	3	4.57
2	12.29	1	2.46
3	13.37	2	3.20
4	15.88	4	3.59
5	16.38	7	3.64
6	16.00	5	3.88
7	16.10	6	3.87
8	19.96	8	5.20
Total	15.76	--	3.93

Table 4-23a

Analysis of Variance of Raw Scores on ETS-II for Classes in the SMSG - Normal Program at End of Grade Eight

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	934.82	7	133.55	8.63 [a]
Within Groups	3002.29	194	15.48	
TOTAL	3937.11	201		

[a] Significant at or beyond the .05 level .

Table 4-24

Means, Ranks and Standard Deviations of ETS-II Raw Scores for Classes in the SMSG - Accelerated Program at End of Grade Eight.

Class	Mean	Rank	S.D.
1	18.77	6	3.96
2	14.67	1	2.89
3	17.48	3	4.94
4	17.11	2	3.95
5	17.67	4	3.20
6	18.32	5	4.27
Total	17.29	--	3.93

Table 4-24a

Analysis of Variance of Raw Scores on ETS-II for Classes in the SMSG - Accelerated Program at End of Grade Eight.

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	301.14	5	60.23	3.90 ☿
Within Groups	2379.63	154	15.45	
TOTAL	2680.77	159		

☿ Significant at or beyond the .05 level.

Table 4-25

Means, Ranks and Standard Deviations of ETS-II Raw Scores
for Classes in the UICSM-8 Program
at End of Grade Eight.

Class	Mean	Rank	S.D.
1	17.07	4	4.68
2	14.17	1	3.11
3	21.40	8	2.64
4	16.69	3	4.59
5	19.54	7	4.25
6	15.50	2	3.87
7	17.69	5	3.44
8	18.72	6	4.08
Total	17.57	--	3.93

Table 4-25a

Analysis of Variance of Raw Scores on ETS-II
for Classes in the UICSM-8 Program
at End of Grade Eight.

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	843.98	7	120.57	7.80 ∜
Within Groups	3137.63	204	15.46	
TOTAL	3981.61	211		

∜ Significant at or beyond the .05 level.

Table 4-26

Means, Ranks and Standard Deviations of ETS-II Raw Scores for Classes in the UICSM-7 Program at the End of Grade Eight.

Class	Mean	Rank	S.D.
1	18.22	4	3.36
2	15.50	2	3.01
3	17.25	3	3.91
4	18.59	5	3.73
5	15.44	1	3.98
Total	17.01	-	3.63

Table 4-26a

Analysis of Variance of Raw Scores on ETS-II for Classes in the UICSM-7 Program at the End of Grade Eight.

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	227.85	4	59.96	4.31 [a]
Within Groups	1610.12	123	13.20	
TOTAL	1837.97	127		

[a] Significant at or beyond the .05 level.

Table -4-27

Means, Ranks and Standard Deviations of ETS-II Residual Scores
For Classes in the Standard Enriched Program
at the End of Grade Eight.

Class	Mean	Rank	S.D.
1	2.5010	12	4.00
2	-0.6567	6	3.06
3	-0.6024	7	3.23
4	0.2811	10	3.07
5	-1.3110	3	2.58
6	0.0492	9	2.92
7	0.3304	11	3.48
8	-2.1890	1	3.09
9	-0.6896	5	3.42
10	-0.4142	8	3.13
11	-1.2728	4	2.46
12	-1.6288	2	2.22
Total	-0.536	--	3.06

Table 4-27a

Analysis of Variance of ETS-II Residual Scores
of Classes in the Standard Enriched Program
at End of Grade Eight.

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	416.28	11	37.84	4.05 [a]
Within Groups	2888.84	309	9.35	
TOTAL	3305.12	320		

[a] Significant at or beyond the .05 level.

Table 4-28

Means, Ranks and Standard Deviations of ETS-II Residual Scores For Classes in the Standard Accelerated Program at the End of Grade Eight.

Class	Mean	Rank	S.D.
1	-2.7979	2	2.56
2	-3.9694	1	2.68
3	-0.9723	9	2.56
4	1.9189	6	3.80
5	-1.1399	8	3.51
6	-2.5858	3	2.47
7	-2.5710	4	4.13
8	-2.5261	5	3.42
9	0.1699	10	3.05
10	-1.3469	7	3.65
Total	-1.514	--	3.26

Table 4-28a

Analysis of Variance of Residual Scores of ETS-II for Classes in the Standard Accelerated Program at End of Grade Eight.

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	594.49	9	66.05	6.22 ☤
Within Groups	2527.30	238	10.62	
TOTAL	3121.79	247		

☤ Significant at or beyond the .05 level.

Table 4-29

Means, Ranks and Standard Deviations of ETS-II Residual Scores
for Classes in the SMSG - Normal Program
at End of Grade Eight.

Class	Mean	Rank	S.D.
1	0.0964	5	3.74
2	-1.2498	3	3.16
3	-1.7465	1	2.43
4	0.1008	6	3.85
5	-0.3091	4	3.62
6	0.4745	7	3.43
7	-1.4206	2	3.65
8	2.6539	8	4.53
Total	-0.205	--	3.51

Table 4-29a

Analysis of Variance of Residual Scores on ETS-II
for Classes in the SMSG - Normal Program
at End of Grade Eight.

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	372.53	7	53.22	4.33 [a]
Within Groups	2385.87	194	12.30	
TOTAL	2758.40	201		

[a] Significant at or beyond the .05 level.

Table 4-30

Means, Ranks and Standard Deviations of ETS-II Residual Scores for Classes in the SMSG -Accelerated Program at End of Grade Eight.

Class	Mean	Rank	S.D.
1	1.8736	5	3.77
2	-0.6889	1	2.97
3	0.4297	3	4.45
4	-0.2696	2	3.71
5	1.8357	4	2.23
6	1.8877	6	3.74
Total	0.796	--	3.56

Table 4-30a

Analysis of Variance of Residual Scores on ETS-II for Classes in the SMSG - Accelerated Program at End of Grade Eight.

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	192.09	5	38.42	3.03 [a]
Within Groups	1951.71	154	12.67	
TOTAL	2143.80	159		

[a] Significant at or beyond the .05 level.

Table 4-31

Means, Ranks and Standard Deviations of ETS-II Residual Scores
for Classes in the UICSM-8 Program
at End of Grade Eight.

Class	Mean	Rank	S.D.
1	0.8072	4	3.50
2	0.1877	2	2.62
3	3.8381	8	2.28
4	0.5835	3	3.81
5	3.1972	7	4.81
6	-0.4987	1	3.48
7	2.1086	5	3.40
8	2.7606	6	3.96
Total	1.5710	--	3.60

Table 4-31a

Analysis of Variance of Residual Scores on ETS-II
for Classes in the UICSM-8 Program
at End of Grade Eight.

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	428.71	7	61.25	4.73 ϑ
Within Groups	2640.12	204	12.94	
TOTAL	3068.83	211		

ϑ Significant at or beyond the .05 level.

Table 4-32

Means, Ranks and Standard Deviations of ETS-II Residual Scores
for Classes in the UICSM-7 Program
at End of Grade Eight

Class	Mean	Rank	S.D.
1	2.1476	5	2.94
2	-0.3396	1	2.69
3	1.5295	3	3.03
4	2.0968	4	3.29
5	-0.3122	2	3.81
Total	1.0150	--	3.19

Table 4-32a

Analysis of Variance of Residual Scores on ETS.-II
for Classes in the UICSM-7 Program
at End of Grade Eight

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	163.14	4	40.78	4.00 [a]
Within Groups	1255.53	123	10.21	
TOTAL	1418.67	127		

[a] Significant at or beyond the .05 level

ETS-II Raw Scores. Each of the six class-within-program analyses of variance of raw scores on the Mathematics Achievement Test yielded significant F ratios. The differences between highest and lowest scoring class in each program were about of the same magnitude as on the Developed Mathematical Abilities Test. The mean high-low classroom difference was 5.91, about 2.7 points greater than the difference between the highest and lowest program means. (See Tables 4-21-4-26 and 4-21a-4-26a.)

ETS-II - Residual Scores. All the analyses of the residual scores by class-within-program yielded significant F ratios. Although mean differences among classes decreased somewhat, they still differed significantly even after IQ, reading ability, arithmetic ability and the other pupil factors were controlled. The average difference between highest and lowest class was 3.77, about two points lower than in the raw score analysis. The greatest difference between residual program means was 3.09. (See Tables 4-27 to 4-32 and 4-27a through 4-32a).

Relationship Between Raw and Residual Class Means. To assess the degree to which classes retained their position within programs after regression on the seven independent variables, a series of rank order correlations was computed between mean raw and mean residual scores for each of the ETS tests.

Table 4-33

Rank Order Correlations Between Raw and Residual Score Means for Classes in Each of the Six Mathematics Programs at the End of Grade Eight.

	ETS-I			ETS-II		
Program	N	Σd^2	R	N	Σd^2	R
1. Standard Enriched	12	79.50	.72	12	142	.50
2. Standard Accelerated	10	110.50	.33	10	82	.50
3. SMSG-Normal	[illegible]	26	.69	8	42	.50
4. SMSG-Accelerated		8	.77	8	2	.94
5. UICSM-8	8	20	.76	8	2	.98
6. UICSM-7	5	0	1.00	5	4	.80

Since the multiple R from the regression equations was somewhat larger for ETS-I than for ETS-II (.60 as compared to .50), (See Table C-1.), it would have been expected that residual scores would differ more from raw scores on ETS-I than on ETS-II. However, this expectation was fulfilled in only some of the programs. For Standard Accelerated, SMSG-Accelerated and UICSM-8 Programs, changes in rank order were greater on ETS-I, as expected, but for the other three programs, the reverse was true. To a large extent, the variations among classrooms on both instruments must be attributed to factors other than initial pupil abilities and attitudes.

Relationship Between ETS-I and ETS-II Class Means. Rank order correlations computed between class means within programs on the two tests, for both raw and residual socres, yielded, as expected, considerably higher correlations for the raw scores. The mean rank order correlation for the raw score means was .70; for the residuals, .42.

Table 4-34

Rank Order Correlations Between ETS-I and ETS-II Raw and Residual Class Means at the End of Grade 8.

Program	Scores: Raw N	Raw Σd^2	Raw R	Residual N	Residual Σd^2	Residual R
1. Standard Enriched	12	62	.78	12	137.25	.52
2. Standard Accelerated	10	30	.82	10	106.50	.36
3. SMSG-Normal	8	8	.90	8	24	.72
4. SMSG-Accelerated	6	32	.09	6	28	.20
5. UICSM-8	8	4	.95	8	22	.74
6. UICSM-7	5	6	.70	5	10	.50

Teacher Made Tests. As noted above, the teachers in each program, with the assistance of their consultant, constructed a test designed to assess mastery of the material covered by each of the classes in each program. Thus, each of the six tests consisted only of content which, according to the best judgment of the teachers, had been covered in their classes.

Since each of the six tests was administered only to the pupils in the program for which it had been constructed, the regression analyses were performed within-program. (See Table C-3 in Appendix C). On the average, the seven independent variables accounted for about one fourth of the variance of TMT scores as they had on ETS-II.

Raw Scores. Inter-class differences were significant in all programs except the Standard Enriched. In the latter, the difference between highest and lowest scoring class was about 3.6 points; for the other programs the average high-low difference was 4.8 points.

The tests varied considerably in difficulty. The Standard Enriched pupils scored considerably higher on their test than did pupils in any other programs. The pupils in the UICSM-7 classes had the lowest scores and showed the greatest heterogeneity, both among classes and among pupils (See Tables 4-35 through 4-40, and 4-35a through 4-40a.)

Residual Scores. Analyses of variance of the residual scores yielded significant F ratios for all programs, even for the Standard Enriched which had shown no significant differences on the raw score analyses (See Tables 4-35b through 4-40b). High-low class differences decreased for the Standard Accelerated, the SMSG-Normal and the SMSG-Accelerated programs, but increased for the Standard Enriched and the two UICSM programs. Thus, controlling for pupil ability and attitudes toward mathematics, did relatively little to decrease class achievement differences, although pupil variability decreased in all

Table 4-35

Means, Ranks and Standard Deviations and Ranges on Teacher-Made Test Raw and Residual Scores for Classes in the Standard Enriched Program at the End of Grade Eight.

	Raw Scores				Residuals		
Class	Mean	Rank	S.D.	Range [a]	Mean	Rank	S.D.
1	21.28	12	3.31	17-25	2.14	12	3.56
2	17.62	1	3.53	12-24	-1.58	1	2.49
3	17.93	2	3.45	13-24	0.49	9	3.21
4	19.13	9.5	3.47	12-25	0.59	10	3.46
5	18.76	6	3.26	13-25	0.00	7	2.21
6	19.00	7.5	3.44	13-24	-0.24	5	2.40
7	18.81	5	4.87	15-24	-0.54	3	4.52
8	19.00	7.5	3.36	15-24	-0.39	4	2.68
9	19.13	9.5	3.66	12-24	0.21	8	3.11
10	18.19	3	4.00	12-24	-0.90	2	3.27
11	18.38	4	2.94	15-24	-0.03	6	2.85
12	19.25	11	2.74	13-24	0.86	11	2.32
Total	18.88	-	3.55	12-25	0.00	-	3.04

[a] Ranges reported only for raw scores.

Table 4-35a

Analysis of Variance of Raw Scores on TMT for Classes in the Standard Enriched Program at the End of Grade Eight.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	231.14	11	21.01	1.67
Within Groups	3909.90	309	12.61	
Total	4141.04	320		

Table 4-35b

Analysis of Variance of Residual Scores of TMT for Classes in the Standard Enriched Program at the End of Grade Eight.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	254.88	11	23.17	2.50 [b]
Within Groups	2874.30	309	9.27	
Total	3129.18	320		

[b] Significant at or beyond the .05 level.

Table 4-36

Means, Ranks, Standard Deviations and Ranges On Teacher-Made Test Raw and Residual Scores for Classes in the Standard-Accelerated Program at the End of Grade Eight.

	Raw Scores				Residuals		
Class	Mean	Rank	S.D.	Range [a]	Mean	Rank	S.D.
1	18.24	8	3.81	13-25	1.58	9	3.34
2	18.62	10	3.68	13-25	2.31	10	3.52
3	15.79	4	4.79	6-24	-0.49	4	4.36
4	18.50	9	4.05	9-25	1.47	8	3.61
5	14.53	2	2.80	12-19	-0.51	3	2.52
6	16.57	5.5	3.11	12-22	-0.44	5	3.05
7	16.57	5.5	2.89	11-24	-0.27	6	2.93
8	13.61	1	3.01	8-19	-1.75	1	2.56
9	17.24	7	3.73	8-24	0.49	7	3.20
10	15.68	3	3.63	7-23	-1.45	2	3.87
Total	16.46	-	3.63	6-25	0.00	-	3.37

[a] Ranges reported only for raw scores

Table 4-36a

Analysis of Variance of Raw Scores of the TMT for Classes in the Standard Accelerated Program at the End of Grade Eight.

Source of Variance	Sum of Squares	d.f.	Est. Mean Squares	F
Among Means	559.46	9	62.16	4.72 [a]
Within Groups	3136.22	238	13.18	
Total	3695.68	247		

[a] Significant at or beyond the .05 level.

Table 4-36b

Analysis of Variance of Residual Scores on the TMT for Classes in the Standard Accelerated Program at the End of Grade Eight.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	372.84	9	41.43	3.66 [a]
Within Groups	2697.30	238	11.33	
Total	3070.14	247		

[a] Significant at or beyond the .05 level.

Means, Ranks, Standard Deviations and Ranges on the Teacher-Made Test Raw and Residual Scores for Classes in the SMSG-Normal Program at the End of Grade Eight.

Class	Raw Scores Mean	Rank	S.D.	Range [a]	Residuals Mean	Rank	S.D.
1	16.53	4	3.50	11-24	1.10	7	3.05
2	14.05	2	3.87	7-20	0.23	3	3.32
3	11.78	1	3.25	5-16	-3.18	1	3.16
4	17.25	8	4.25	10-23	0.39	4.5	3.47
5	15.50	3	4.05	6-23	0.47	6	3.25
6	16.55	5	4.07	11-25	1.47	8	3.17
7	16.79	7	2.35	12-21	-0.47	2	2.44
8	16.70	6	4.34	11-25	0.39	4.5	3.53
Total	15.75	-	3.73	5-25	0.00	-	3.18

[a] Ranges reported only for raw scores.

Table 4-37a

Analysis of Variance of Raw Scores on the TMT for Classes in the SMSG-Normal Program at the End of Grade Eight.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	378.54	7	54.08	3.88 [a]
Within Groups	2689.02	194	13.93	
Total	3067.56	201		

[a] Significant at or beyond the .05 level.

Table 4-37b

Analysis of Variance of Residual Scores on the TMT for Classes in the SMSG-Normal Program at the End of Grade Eight.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	376.71	7	53.82	5.33 [a]
Within Groups	1948.66	194	10.10	
Total	2325.37	201		

[a] Significant at or beyond the .05 level.

Table 4-38

Means, Ranks, Standard Deviations and Ranges on Teacher-Made Test Raw and Residual Scores for Classes in the SMSG-Accelerated Program at the End of Grade Eight.

Class	Raw Scores Mean	Rank	S.D.	Range [a]	Residuals Mean	Rank	S.D.
1	16.32	6	2.14	12-22	1.15	6	2.56
2	11.48	1	3.06	8-18	-2.11	1	3.16
3	16.13	5	3.65	5-21	0.52	4	3.46
4	15.89	4	3.52	8-22	-0.11	2	3.13
5	14.52	2	3.91	4-24	0.37	3	3.23
6	15.12	3	3.89	5-24	0.59	5	3.55
Total	14.80	--	3.41	4-24	0.00	--	3.20

[a] Ranges reported only for raw scores.

Table 4-38a

Analysis of Variance of Raw Scores on the TMT for Classes in the SMSG-Accelerated Program at the End of Grade Eight.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	476.39	5	95.28	8.17 [a]
Within Groups	1795.21	154	11.66	
Total	2271.60	159		

[a] Significant at or beyond the .05 level.

Table 4-38b

Analysis of Variance of Residual Scores on the TMT for Classes in the SMSG Accelerated Program at the End of Grade Eight.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	103.56	5	38.71	3.78 [a]
Within Groups	1578.06	154	10.25	
Total	1771.62	159		

[a] Significant at or beyond the .05 level.

Table 4-39.

Means, Ranks, Standard Deviations and Ranges on Teacher-Made Test Raw and Residual Scores for Classes in the UICSM-8 Program at the End of Grade Eight.

	Raw Scores				Residuals		
Class	Mean	Rank	S.D.	Range[a]	Mean	Rank	S.D.
1	16.78	4	4.34	3-22	-0.86	2	3.41
2	16.55	3	3.95	12-24	0.91	5	3.25
3	19.70	8	1.89	17-24	1.02	6	1.62
4	16.46	2	3.87	10-23	-0.73	4	3.94
5	17.18	6	3.72	10-23	-1.12	1	3.52
6	15.62	1	2.54	13-25	-0.74	3	3.39
7	19.36	7	3.95	12-22	1.50	7	2.64
8	17.04	5	4.01	16-25	3.45	8	2.11
Total:	17.42	-	3.67	3-25	0.00	-	3.08

[a] Ranges reported only for raw scores.

Table 4-39a.

Analysis of Variance of Raw Scores on TMT for Classes in the UICSM-8 Program at the End of Grade Eight.

Source of Variance	Sum of Squares	d.f.	Est. Mean Squares	F
Among Means	410.65	7	58.66	4.36[a]
Within Groups	2744.99	204	13.46	
Total	3155.64	211		

[a] Significant at or beyond the .05 level.

Table 4-39b.

Analysis of Variance of Residual Scores of TMT for Classes in the UICSM-8 Program at the End of Grade Eight.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	541.07	7	77.30	8.13[a]
Within Groups	1939.76	204	9.51	
Total	2480.83	211		

[a] Significant at or beyond the .05 level.

Table 4-40

Means, Ranks, Standard Deviations and Ranges on Teacher-Made Test Raw and Residual Scores for Classes in the UICSM-7 Program at the End of Grade Eight.

	Raw Scores				Residuals		
Class	Mean	Rank	S.D.	Range	Mean	Rank	S.D.
1	15.77	5	3.80	10-22	2.72	5	2.84
2	10.00	1	3.34	5-16	-3.25	1	3.65
3	14.42	3	3.78	5-22	1.55	4	3.11
4	14.50	4	4.41	7-23	1.25	3	4.05
5	10.19	2	4.06	4-19	-1.97	2	3.28
Total	12.91	-	3.92	4-23	0.00	-	3.45

a Ranges reported only for raw scores

Table 4-40a

Analysis of Variance of Raw Scores on TMT for Classes in the UICSM-7 Program at the End of Grade Eight.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	722.78	4	180.70	11.75[a]
Within Groups	1891.27	123	15.38	
Total	2614.05	127		

a Significant at or beyond the .05 level.

Table 4-40b

Analysis of Variance of Residual Scores of TMT for Classes in the UICSM-7 Program at the End of Grade Eight.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	634.81	4	158.70	13.30[a]
Within Groups	1467.76	123	11.93	
Total	2102.57	127		

a Significant at or beyond the .05 level.

the programs. It would appear that the quality of the teaching in the various classes was a stronger determinant of class achievement on the intra-program tests than on the more general Developed Mathematical Abilities Test and even on the cross-program achievement test.

Relationship Between Raw and Residual Class Means. Rank order correlations between raw and residual class means varied greatly from program to program. In the Standard Accelerated and the UICSM-7 programs there was very little change of class order. In the SMSG-Normal program there was little consistency. (See Table 4-41.) It would appear that in some of the programs the achievement of the pupils was less dependent on their abilities and attitudes, more on teaching procedures, while in other programs, the reverse was true.

Table 4-41

Rank Order Correlations Between Raw and Residual Class Means on the Teacher Made Tests for the Six Mathematics Programs at the End of Grade Eight.

	Program	N	Σd^2	R
1.	Standard Enriched	12	160.90	.44
2.	Standard Accel.	10	4.50	.97
3.	SMSG-Normal	8	67.75	.20
4.	SMSG-Accel.	6	10	.71
5.	UICSM-8	8	54	.36
6.	UICSM-7	5	2	.90

Relationships Between ETS-II and the TMT's. Rank order correlations computed between ETS-II and TMT scores (both raw and residual) for each program suggested that the degree to which the two kinds of measures assessed achievement of the same material varied greatly from program to program. For the four contemporary programs, rank order correlations by classes ranged from a low of .52 for SMSG-Normal raw scores to a high of .90 for UICSM-7 residuals. For the two standard programs there was either no significant relationship or a negative one.

Table 4-42

Rank Order Correlations Between Scores on the TMT's and on ETS-II (Raw and Residual) for Classes in Each of Six Mathematics Programs at the End of Grade 8.

		Scores			
		Raw		Residual	
Program	N	Σd^2	R	Σd^2	R
1. Standard Enriched	12	279	.02	264	.08
2. Standard Accel.	10	148.25	.11	242	-.47
3. SMSG-Normal	8	40	.52	23.50	.62
4. SMSG-Accelerated	6	16	.54	4	.89
5. UICSM-8	8	12	.86	20	.76
6. UICSM-7	5	4	.80	2	.90

In general, the material included in the Mathematics Achievement Test (ETS-II) had more in common with what the teachers believed they had taught during the course of the year in classes in the four contemporary programs than in the two standard ones.

CHAPTER V

Ninth Grade Results

By the spring of 1964 it became clear that many of the original classes would not remain in the study through the ninth grade. Despite initial commitments, a number of the New York State systems which had classes in the Standard Accelerated program, insisted that the Regent's examinations forced them to move their classes into geometry (or Math 10) rather than the intermediate algebra (or Math 11) which the experimental conditions required. A number of other districts could not retain their ninth grade classes intact as a result of crowded double-session conditions in the senior high schools into which their ninth grades moved. In one or two other situations, there was strong pressure to inclued "modern" mathematics in classes which had been following a traditional pattern until that time and the classes were, therefore, dropped from the experiment. In one of the UICSM-8 classes the teacher mistakenly followed an incorrect sequence and was, therefore eliminated from most of the analyses.

As a result of the various field complications, the number of participating classes decreased from a total of 49 at the end of grade eight to a total of 37 at the end of grade nine. (See Table 5-1).

Table 5-1

Number of Classes and Pupils By Program
in Each of the Seven [a] Mathematics Programs
at the End of Grade Nine

Program	No. of Classes	No. of Pupils
1 Standard Enriched	11	269
2 Standard Accelerated-geometry	5	105
3 [a] Standard Accelerated-algebra	1	25
4 SMSG-Normal	5	114
5 SMSG-Accelerated	4	93
6 UICSM-8	6	142
7 UICSM-7	5	120
Total	37	868

[a] One of the Standard Accelerated classes (designated as program 3) followed a 2nd year algebra rather than the geometry sequence used by the other five classes and was either eliminated or treated separately in the data analyses.

The teacher groups each met with their consultants three or four times during the school year. The in-service sessions dealt with the new material to be covered during the ninth year and with problems encountered by the teachers. Toward the end of the year the consultants for each program prepared Teacher-Made Tests based on material proposed by the teachers.

As a result of the exigencies of the field situation, an attempt was made to modify somewhat the design of the study without violating its initial intent. Although it was still possible to compare standard to contemporary and accelerated to enriched programs, a further division between algebra and geometry was considered.

Table 5-2

Number of Classes in Each Type of Program
By Pace, Approach and Content

Standard Approach

Pace	Algebra Program	Algebra # Classes	Geometry Program	Geometry # Classes
Enriched	St. Enr.	11	---	0
Accelerated	St. Acc.	1	St. Acc.	5

Contemporary Approach

Pace	Algebra Program	Algebra # Classes	Geometry Program	Geometry # Classes
Enriched	SMSG-N	5	---	0
Accelerated	SMSG-Acc. UICSM-8	4 5	UICSM-7	5

Unfortunately, as can be seen from Table 5-2, there were no classes engaged in either the contemporary or standard enriched geometry programs and only one in standard accelerated algebra. Thus, it was not possible to follow the modified design in the analyses of test scores.

Therefore, analyses by program were, as before, limited to comparisons along the dimensions of approach and pace and only incidentally took account of content.

The cross-program analyses of total scores for both the Developed Mathematical Abilities Test (ETS-I) and the Mathematics Achievement Test (ETS-II) were performed on the 868 pupils as presented in Table 5-1. In these analyses, the 25 pupils in the Standard Accelerated-Algebra class were treated as members of a separate program. It was thus possible to see what effect this program had on the pupils developed mathematical abilities, as well as to see how they performed on an achievement test which drew no material from their program.

For the sub-test analyses, however, the Standard-Accelerated - Algebra class was eliminated, since no sub-test was developed around its course of study and its performance on "own" and "other" content could not be compared. The sub-test analyses were thus based on a population of 843 pupils in a total of 36 classes. Similarly, the within program analyses on the ETS-tests and the TMT's included only the 36 classes.

For the Questionnaire on Mathematics inventory and the Abilities Self-Rating Scale 22 and 23 pupils, respectively, lacked either 7th or 9th grade scores and were thus eliminated; but the UICSM-8 class which had mistakenly covered the "wrong" material and had been excluded from the various achievement test analyses, was, nevertheless, included in the study of attitudes and abilitites self-rating. The total number of pupils for this part of the study was 872 and 871, respectively.

For the longitudinal correlational analysis performed at the end of grade nine, in which all measures for each of the three years were included, the population was reduced to the 813 pupils who had scores on all of the instruments for each year.

Analysis of Test Results

At the end of grade nine, which represented the terminal point of the study, pupils were tested on 9th grade forms of the Developed Mathematical Abilities Test (ETS-I)and the Mathematics Achievement Test (ETS-II). As in previous years, ETS-I was composed largely of items drawn from the Scholastic Aptitude Test item pool. ETS-II was developed from the material covered by each of the six programs and distributed among six sub-tests, each based on the content of a particular program. Each program was also tested on a separate Teacher-Made Test (TMT). In addition, the Questionnaire on Mathematics and the Abilities Self-Rating Scale, both of which had been administered at the beginning of grade seven, were re-administered.

Scores on the Developed Mathematical Abilities and Mathematics Achievement tests were again regressed on the seven independent variables used in previous years, with regression analyses based on the total population. (See Table D-1, Appendix D). The regression analyses of the TMT scores were performed separately for each program. The attitude test scores were analyzed by a covariance design, in which seventh grade scores were used to adjust ninth grade scores.

Developed Mathematical Abilities - ETS-I Raw Scores. Means on ETS-I ranged from 15.39 for the Standard Enriched to 19.58 for the SMSG-Accelerated program. The standard deviations were fairly homogeneous, ranging from a high of 4.4 for SMSG-Accelerated to a low of 3.5 for the single Standard Accelerated-algebra class. (See Table 5-3).

A one-way analysis of variance of ETS-I Raw Scores across the seven programs (See Table 5-4) yielded a significant F ratio. Contrasts among program means found that the Standard Enriched program fell significantly below each of the other six; Standard Accelerated-geometry fell below Standard Accelerated-algebra and both SMSG programs; SMSG-Accelerated scored significantly above five of the other six programs, failing to differ significantly only from the Standard Accelerated-algebra class; UICSM-7 scored significantly lower than the Standard Accelerated-algebra class and each of the two SMSG programs; UICSM-8 scored below SMSG-Accelerated but did not differ significantly from UICSM-7, SMSG-Normal or from either of the Standard programs.

The mean of the contemporary program cluster was significantly higher than the mean of the standard one and the Accelerated programs scored significantly higher than the Enriched.

Table 5-3

Means, Ranks, Standard Deviations and Ranges [a] of ETS-I Raw and Residual Scores for Pupils in Seven [b] Mathematics Programs at the End of Grade Nine.

Program	N	ETS-I Raw Scores				ETS-I Residual Scores		
		$\bar{X}$	Rank	S.D.	Range [a]	$\bar{X}$	Rank	S.D.
Standard Enriched	269	15.3866	1	4.39	5-27	- .5248	2	3.74
Standard Accel.-Geom.	105	17.0666	3	3.64	8-25	-1.0665	1	3.41
Standard Accel.-Alg.	25	18.7600	6	3.47	11-23	.3995	5	3.05
SMSG-Normal	114	18.2456	5	4.10	11-29	.2826	4	3.37
SMSG-Accel.	93	19.5806	7	4.42	9-29	1.3652	7	3.98
UICSM-8	142	17.6690	4	4.03	8-27	.7486	6	3.32
UICSM-7	120	16.8416	2	4.15	7-29	- .3107	3	3.37
Total	868	17.086		4.36		- .017		3.61

[a] Ranges reported for raw scores only.

[b] Program 3 includes only the one Standard Accelerated class which followed a second year algebra sequence.

Table 5-4

Analysis of Variance[b] of Raw Scores on ETS-I for Pupils in Seven Mathematics Programs at the End of Grade Nine.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	1634.41	6	272.40	15.77 [a]
Within Groups	14874.12	861	17.28	
Total	16508.53	867		

Scheffé Tests

	1	2	3	4	5	6	7
1. St. En.		-1.6800 [a]	-3.3734 [a]	-2.1950 [a]	-4.1940 [a]	-2.2824 [a]	-1.4550 [a]
2. St. Acc.-Geom.			-1.6934 [a]	-1.1790 [a]	-2.5140 [a]		
3. St. Acc.-Alg.							1.9184 [a]
4. SMSG-Normal					-1.3350 [a]		1.4040 [a]
5. SMSG-Accel						1.9116 [a]	2.7390 [a]
6. UICSM-8							
7. UICSM-7							

Standard vs. Contemporary = -1.9803 [a]
Enriched vs. Accelerated = -1.5191 [a]

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[a] Significant at or beyond the .05 level

[b] Program 3 includes only the one Standard Accelerated class which followed a second year algebra sequence

ETS-I Residual Scores. When the scores on ETS-I were controlled for initial pupil abilities and attitudes, the rank order of the program means changed. Lowest place was now held by Standard Accelerated-geometry, with Standard Enriched, one above. SMSG-Accelerated maintained its place at the top of the rank order and UICSM-8 moved from fourth place to sixth, one from the top. (See Table 5-3).

A one-way analysis of variance of the residual scores yielded a significant F ratio. Contrasts among program means did not reach significance in as many instances as was true for the raw score contrasts. Both Standard Enriched and Standard Accelerated-geometry fell significantly below each of the SMSG programs and UICSM-8, while SMSG-Normal was exceeded only by SMSG-Accelerated which, along with UICSM-8 scored significantly higher than UICSM-7. (See Table 5-5).

While the contemporary cluster still had a significantly higher mean than the standard one, the enriched and accelerated clusters no longer differed significantly from each other.

In general, the regression had the effect of lowering the relative position of the Standard Accelerated-geometry program and, to a lesser extent, of Standard Accelerated-algebra and SMSG-Normal; while raising the position of both UICSM programs; SMSG-Accelerated remained unaffected.

Mathematics Achievement Test (ETS-II) Raw Scores. As in previous years, mean scores on ETS-II were lower than on ETS-I, despite the greater number of items on the former. The difference in the grand means was about 1.5 points.

UICSM-7 had the highest mean - 19.64, while Standard Enriched was at the bottom of the rank order with a mean of 12.07. SMSG-Accelerated held second place with a mean score of 17.89 while Standard Accelerated-algebra

Table 5-5

Analysis of Variance of Residual Scores on ETS-I for Pupils in Seven[b] Mathematics Programs at the End of Grade Nine.

Source of Variance	Sum of Squares	d.f.	Est. Mean Squares	F
Among Means	470.88	6	78.48	6.24[a]
Within Groups	10831.42	861	12.58	
TOTAL	11302.30	867		

Scheffé Tests

	1	2	3	4	5	6	7
1. Standard Enriched				-.8074[a]	-1.8900[a]	-1.2734[a]	
2. Standard Accel.-Geom.				-1.3491[a]	-2.4317[a]	-1.8151[a]	
3. Standard Accel.-Alg.							
4. SMSG-Normal					-1.0826[a]		
5. SMSG-Accel.							1.6759[a]
6. UICSM-8							1.0593[a]
7. UICSM-7							

UICSM-8: Standard vs. Contemporary = -1.0960[a]
Enriched vs. Accelerated = n.s.

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[a] Significant at or beyond the .05 level.

[b] Program 3 includes only the one Standard Accelerated class which followed a second year algebra sequence.

held the next to last rank with a mean of 15.00. However, the variances were not uniformly homogeneous. Although the standard deviations for six of the programs fell between 3.6 and 5.0, UICSM-8 had a standard deviation of 10.32. (See Table 5-6).

A one-way analysis of variance of ETS-II raw scores across the seven programs yielded a significant F ratio. (See Table 5-7). Contrasts among program means found Standard Enriched significantly below each of the others and UICSM-7 significantly above all other programs. SMSG- Accelerated exceeded all but Standard Accelerated-geometry and UICSM-7. It was interesting to note that the Standard Accelerated-alegebra class whose course of study was not represented on the test, did better than Standard Enriched for whom 1/6 of the test was derived from their own program.

Both cluster contrasts showed significant differences. The contemporary programs exceeded the standard ones; the accelerated exceeded the enriched.

ETS-II Residual Scores. The residual means fell in the same rank order as the raw score means. Standard Enriched, Standard Accelerated-algebra and UICSM-8, on the average, each fell below expectation. The other four programs scored above expectation. The variances were homogeneous.

A one-way analysis of variance across the seven programs yielded a significant F ratio. Contrasts among program means still placed Standard Enriched significantly below all but Standard Accelerated-algebra, suggesting that the initial high ability of the algebra class was responsible for its relatively high raw score performance. UICSM-7 scored significantly higher than each of the other six programs and SMSG-Accelerated exceeded all but UICSM-7.

The cluster contrasts found the contemporary and accelerated programs significantly higher than the standard and enriched, repectively. (See Table 5-8).

Table 5-6

Means, Ranks, Standard Deviations and Ranges [a] of ETS-II Raw and Residual Scores for Pupils in Seven [b] Mathematics Programs at the End of Grade Nine.

Program	N	ETS-II - Raw $\bar{X}$	Rank	S.D.	Range	ETS-II Residual $\bar{X}$	Rank	S.D.
Standard Enriched	269	12.0706	1	3.63	4-21	-2.1088	1	3.77
Standard Accel.-Geom.	105	16.4761	5	4.22	5-26	.1540	5	3.99
Standard Accel.-Alg.	25	15.0000	2	3.79	8-22	-1.8366	2	4.09
SMSG-Normal	114	16.3070	4	4.51	0-27	.1518	4	3.72
SMSG-Accel.	93	17.8924	6	5.01	6-31	1.3046	6	4.30
UICSM-8	142	15.5314	3	10.32	4-30	- .6503	3	4.09
UICSM-7	120	19.6416	7	4.56	9-31	4.0342	7	4.05
Total	868	15.481		6.25		- .076		4.41

a Ranges reported for raw scores only.

b Program 3 includes only the one Standard Accelerated class which followed a second year algebra sequence.

Table 5-7

Analysis of Variance of Raw Scores on ETS-II for Pupils in Seven[b] Mathematics Programs at the End of Grade Nine.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	5934.70	6	989.17	30.53[a]
Within Groups	27930.25	861	32.40	
Total	33864.95	867		

Scheffé Tests

	1	2	3	4	5	6	7
1. St. En.		-4.4055[a]	-2.9294[a]	-4.2364[a]	-5.8218[a]	-3.4608[a]	-7.5710[a]
2. St. Acc.-Geom.							-3.1655[a]
3. St. Acc.-Alg.					-2.8924[a]		-4.6416[a]
4. SMSG-Normal					-1.5854[a]		-3.3346[a]
5. SMSG-Accel.						2.3610[a]	-1.7492[a]
6. UICSM-8							-4.1102[a]
7. UICSM-7							

Standard vs. Contemporary = -3.8263[a]
Enriched vs. Accelerated = -3.8466[a]

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a Significant at or beyond the .05 level.

b Program 3 includes only the one Standard Accelerated class which followed a second year algebra sequence.

Table 5-8

Analysis of Variance of[b] Residual Scores on ETS-II for Pupils in Seven Mathematics Programs at the End of Grade Nine.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	3452.02	6	575.34	36.87[a]
Within Groups	13433.85	861	15.60	
Total	16885.87	867		

Scheffe Tests

	1	2	3	4	5	6	7
1. St. En.		-2.2628[a]		-2.2606[a]	-3.4134[a]	-1.4585[a]	-6.1430[a]
2. St. Acc.-Geom.			-1.9906[a]		-1.1506[a]		-3.8802[a]
3. St. Acc.-Alg.				-1.9874[a]	-3.1412[a]		-5.8708[a]
4. SMSG-Normal					-1.1528[a]		-3.8824[a]
5. SMSG-Acc.						1.9549[a]	-2.2796[a]
6. UICSM-8							-4.6845[a]
7. UICSM-7							

Standard vs. Contemporary = -2.6295[a]
Enriched vs. Accelerated = -2.4693[a]

---

[a] Significant at or beyond the .05 level.

[b] Program 3 includes only the one Standard Accelerated class which followed a second year algebra sequence.

ETS-II Sub-test Analyses Raw Scores. The six sub-tests of the Mathematics Achievement Test (ETS-II) were unequal in number of items. Sub-test III (SMSG-Normal), Sub-test IV (SMSG-Accelerated) and Sub-test VI (UICSM-7) each contained six items; Sub-test I (Standard Enriched) and Sub-test V (UICSM-8) contained seven items and Sub-test II (Standard Accelerated) contained eight items. Thus, the means across sub-tests could not be compared directly to each other. Mean per cent of items passed was, therefore, recorded on Table 5-9. The cell representing the mean of each group on its "own" sub-test is designated by ϑ.

Checking down the columns of Table 5-9, Standard Accelerated, SMSG-Normal, and both UICSM programs exceeded all other programs on their "own" sub-test score. The Standard Enriched classes were out-scored on their own material by all but Standard Accelerated while SMSG-Accelerated fell below both Standard Accelerated and UICSM-7 on its "own" sub-test.

Checking across the rows, SMSG-Normal and each of the UICSM programs passed the highest per cent of items on their "own" sub-tests, while the other three programs did better on sub-tests derived from programs other than their own. Standard Enriched did best on the SMSG-Normal sub-test; Standard Accelerated did best on the UICSM-7 sub-test; and SMSG-Accelerated received its highest per cent passed on the SMSG-Normal sub-test. Adding ranks across rows found Standard Enriched at the bottom of the rank order with the lowest sum of ranks (11), SMSG-Accelerated and UICSM-7 with the highest (28 and 27, respectively), and Standard Accelerated and UICSM-8 in the middle (19 and 18, respectively).

A series of one-way analyses of variance of the six sub-tests across the six programs yielded significant F ratios in every instance. (See Tables D-4a through D-4f, Appendix D).

Table 5-9

Mean Scores and Percents, Ranks and Standard Deviations of Raw Scores on the Six Sub-tests of ETS-II for Each of the Six Mathematics Programs at the End of Grade Nine.

	Sub-tests																							
	I [a]				II [b]				III [c]				IV [c]				V [a]				VI [c]			
Program	$\bar{X}$	%	R	S.D.	$\bar{X}$	%	R	S.D.	$\bar{X}$	%	R	S.D.	$\bar{X}$	%	R	S.D.	$\bar{X}$	%	R	S.D.	$\bar{X}$	%	R	S.D.
1.St.Enriched	2.17[d]	31	2	1.23	1.61	20	1	1.15	3.19	53	4	1.49	1.37	23	1	1.01	2.06	30	2	1.24	1.64	27	1	1.07
2.St.Accel.	1.95	28	1	1.22	4.21[d]	51	6	1.59	2.66	44	1	1.40	2.58	43	5	1.14	1.80	26	1	1.20	3.21	54	5	1.15
3.SMSG-Normal	2.40	34	4	1.27	2.06	26	3	1.35	3.96[d]	66	6	1.38	1.90	32	3	1.15	3.76	54	4	1.24	2.30	38	3	1.14
4.SMSG-Accel.	2.83	40	6	1.25	2.50	31	4	1.30	3.74	62	5	1.93	2.34[d]	39	4	1.22	3.88	55	5	1.54	2.55	43	4	1.31
5.UICSM-8	2.38	34	3	1.41	1.67	21	2	1.20	3.16	53	3	1.82	1.74	29	2	1.23	4.11[d]	59	6	1.48	1.66	28	2	1.18
6.UICSM-7	2.55	36	5	1.23	3.88	49	5	1.67	2.87	48	2	1.38	2.67	45	6	1.23	3.57	51	3	1.39	4.04[d]	67	6	1.16

[a] Maximum score = 7

[b] Maximum score = 8

[c] Maximum score = 6

[d] Sub-test composed of material taught in the particular program.

On Sub-test I (Standard Enriched) SMSG-Accelerated scored significantly higher than either of the standard programs and UICSM-7 exceeded Standard Accelerated. The contemporary cluster had a significantly higher mean than the standard one, but the accelerated and enriched cluster did not differ significantly from each other (See Table D-4a, Appendix D).

On its "own" Sub-test II, Standard Accelerated scored significantly above all but UICSM-7 (which also followed a geometry sequence). UICSM-7 also exceeded Standard Enriched, both SMSG programs and UICSM-8, while SMSG-Accelerated scored significantly above Standard Enriched and UICSM-8. The mean of the accelerated cluster was significantly higher than the mean of the enriched; the standard and contemporary clusters did not differ significantly. (See Table D-4b, Appendix D).

On its "own" Sub-test III, SMSG-Normal scored significantly higher than both standard and both UICSM programs, as did SMSG-Accelerated. Standard Enriched exceeded Standard Accelerated. The enriched cluster scored significantly higher than the accelerated one; the contemporary cluster exceeded the standard one. On this sub-test, most programs scored higher than on any other of the sub-tests. (See Table D-4c, Appendix D).

On its Sub-test IV, SMSG-Accelerated did significantly better than Standard Enriched and UICSM-8, but not than the other programs. Both Standard Accelerated and UICSM-7 scored significantly higher than Standard Enriched, SMSG-Normal, and UICSM-8; and SMSG-Normal exceeded Standard Enriched. The accelerated cluster surpassed the enriched, and the contemporary did better than the standard. (See Table D-4d, Appendix D).

On Sub-test V, UICSM-8 dealt more effectively with its "own" content than the two standard programs and UICSM-7. In fact, each of the four contemporary programs scored significantly higher than each of the standard ones. As expected, the contemporary cluster exceeded the standard one, and the accelerated scored above the enriched. (See Table D-4e, Appendix D).

On Sub-test VI, 13 of the possible 15 contrasts were significant. UICSM-7, from whose content the sub-test was developed, scored significantly higher than each of the other five programs; Standard Accelerated exceeded each of the remaining four. Both SMSG-programs did better than UICSM-8 and Standard Enriched. Both cluster contrasts were significant in favor of the accelerated and the contemporary, respectively.

Summary: Sub-test Raw Scores. The analyses of raw sub-test scores found that four of the six programs received higher mean scores on their own sub-test than did any other program. However, Standard Enriched and SMSG-Normal dealt somewhat less effectively with their own material than did other programs to which the material had not been directly taught. Three of the programs - SMSG-Normal and the UICSMs - passed the greatest proportion of items on their own sub-test, while the remaining three did better on sub-tests derived from the material of other programs. From the average per cent of items passed by all groups on each sub-test, number III (SMSG-Normal) appeared to be the easiest (better than half the items were passed, on the average) and number II (Standard Accelerated) the most difficult. (About a third of the items were passed, on the average.)

The analyses of variance for each sub-test across programs yielded significant F ratios. Of the 90 possible contrasts between pairs of means, 50 were significant. Of the 18 times that UICSM-7 differed significantly from some other program 15 favored UICSM-7; whereas in 18 of the 19 significant contrasts in which Standard Enriched figured, it fell significantly below the other programs. Standard Accelerated fell significantly below other programs in 9 contrasts and scored significantly above the others in 10; SMSG-Normal was significantly higher in 9 cases, lower in 6. SMSG-Accelerated figured significantly in 14 contrasts of which 12 were in its favor; while of the 15 involving UICSM-8, 12 favored some other program.

In comparisons between the accelerated and enriched programs, the accelerated cluster scored significantly higher than the enriched on sub-tests II (Standard Accelerated), IV (SMSG-Accelerated), V (UICSM-8) and VI (UICSM-7); in other words, on all four sub-tests derived from the material of the accelerated programs. On Sub-test III (SMSG-Normal), the enriched cluster scored significantly higher than the accelerated one. On Sub-test I (Standard Enriched), there were no significant differences due to pace.

Comparisons between the standard and the contemporary program clusters found the latter significantly higher on five of the sub-tests (I, III, IV, V, VI) and not significantly different on Sub-test II. Thus the contemporary programs exceeded the standard ones not only on the sub-tests derived from contemporary content, but also on the standard material of Sub-test I.

ETS-II Sub-test Analyses: - Residual Scores. When the raw scores were regressed on the seven independent variables and the effects of ability and attitudes toward mathematics partially controlled, there were few changes in the rank order of the programs on each of the sub-tests. (See Table 5-10). SMSG-Normal and both UICSM programs retained top rank on their own sub-test. Standard Accelerated, however, which had ranked highest on its own material when raw scores were considered, was now exceeded by UICSM-7. Inspecting the rows, Standard Accelerated, SMSG-Normal and both UICSM programs achieved their highest scores on their own sub-tests, but Standard Enriched and SMSG-Accelerated did better with content from programs other than their own. Standard Enriched scored at or above expectation only on sub-test III (SMSG-Normal), while UICSM-7 fell below expectation only once, on the same sub-test.

One-way analyses of variance of program residual scores on each of the sub-tests yielded significant *F* ratios. However, the number of significant contrasts dropped substantially. Only 38 of the possible 90 contrasts reached significance as against 50 in the raw score contrasts.

Table 5-10

Means, Ranks and Standard Deviations of Residual Scores on the Six Sub-tests of <u>ETS-II</u> for Each of the Six Mathematics Programs at the End of Grade Nine.

	Sub-tests																	
	I			II			III			IV			V			VI		
Program	$\bar{X}$	Rank	S.D.	$\bar{X}$	Rank	S.D.	$\bar{X}$	Rank	S.D.	$\bar{X}$	Rank	S.D.	$\bar{X}$	Rank	S.D.	$\bar{X}$	Rank	S.D.
1. St. Enriched	-.04[a]	2	1.23	-.55	2	1.16	.10	4	1.22	-.38	1	1.02	-.62	2	1.22	-.54	1	1.09
2. St. Accel	-.23	1	1.13	.78[a]	5	1.67	-.36	2	1.34	.15	4	1.24	-.76	1	1.43	.21	5	1.33
3. SMSG-Normal	-.02	3	1.23	-.57	1	1.24	.62[a]	6	1.12	-.19	2	1.14	.52	4	1.19	-.28	2	1.05
4. SMSG-Accel.	.41	6	1.15	-.21	4	1.24	.62	6	1.12	.23[a]	2	1.14	.52	4	1.19	-.28	2	1.05
5. UICSM-8	.13	4	1.29	-.40	3	1.32	-.04	3	1.25	-.17	3	1.21	1.01[a]	6	1.34	-.22	3	1.36
6. UICSM-7	.23	5	1.20	1.40	6	1.54	-.37	1	1.14	.68	6	1.18	.42	3	1.36	1.59[a]	6	1.17

[a]. Sub-test composed of material taught in the particular program.

On the Standard Enriched Sub-test I, SMSG-Accelerated exceeded Standard Accelerated. None of the other contrasts, either between program or cluster means reached significance. (See Table D-5a, Appendix D).

On its "own" Sub-test II, Standard Accelerated scored significantly higher than all but UICSM-7, while the latter exceeded each of the other five programs. Thus, when the groups were equated on ability, the classes which studied the UICSM version of geometry coped more effectively with the standard geometry content than the standard group, a fact not found in the raw score analyses. The standard and contemporary clusters did not differ significantly from each other; the accelerated scored significantly above the enriched. (See Table D-5b, Appendix D).

On its "own" Sub-test III, SMSG-Normal scored significantly higher than all programs except SMSG-Accelerated, and the latter exceeded Standard Accelerated and UICSM-7. Standard Enriched also scored significantly higher than UICSM-7. There was no significant difference on the supposedly contemporary content of this sub-test between the standard and contemporary cluster. But, as in the raw score contrasts, this was the only sub-test on which the enriched cluster scored significantly higher than the accelerated. (See Table D-5c, Appendix D).

On the SMSG-Accelerated Sub-test IV, UICSM-7 scored significantly higher than four of the remaining five programs. Only when contrasted with SMSG-Accelerated, from whose program the sub-test was derived, did UICSM-7 fail to show superiority. SMSG-Accelerated as well as Standard Accelerated scored significantly higher than Standard Enriched. Both cluster contrasts reached significance: accelerated exceeded enriched and contemporary scored above standard. (See Table D-5d, Appendix D).

On its "own" Sub-test V, UICSM-8 differed significantly from the two standard programs, (as did each of the other three contemporary programs) and also from UICSM-7. In fact, each of the "modern" programs scored above expectation on this sub-test and only in the comparison between the two UICSM programs did one do significantly better than any other. The accelerated and contemporary program clusters had significantly higher means than the enriched and standard clusters, respectively. (See Table D-5e, App. D).

On the UICSM-7 Sub-test VI, the only contrasts which remained significant after regression were those between UICSM-7 and each of the other programs and the one between Standard Accelerated and Standard Enriched. The remaining seven contrasts, which reached significance when raw score means were compared, were no longer significant in the residual comparisons. But while UICSM-7 exceeded all others on the standard as well as the contemporary geometry content, the Standard Accelerated program, which also studied geometry, exceeded only the consistently low Standard Enriched on the contemporary geometry material of this sub-test. (See Table D-5f, Appendix D).

Summary: Sub-test Residuals. The regression of sub-test scores had the effect of generally raising the scores of the two UICSM programs and lowering those of SMSG-Normal. Standard Enriched retained its low position, failing to reach expectation on five of the six sub-tests, including its own. SMSG-Normal, and UICSM-8 scored below expectation on four of the six sub-tests -- the former achieved a positive residual mean score only on its own (III) and the UICSM-8 (V) sub-tests, while the latter attained or exceeded expectation on Standard Enriched (I) and its own (V).

Standard Accelerated exceeded expectaion on the two geometry sub-tests, its own and UICSM-7's as well as on the material derived from the SMSG-Accelerated content. SMSG-Accelerated fell below expectation only on the two geometry sub-tests. In general, applying knowledge derived from some kind of algebra sequence to solving geometry problems and vice versa, seemed most difficult for all groups.

On four of the six sub-tests (two based on algebra, two on geometry) the accelerated programs exceeded the enriched and only on the SMSG-Normal sub-test did the enriched cluster score significantly higher. On the Standard Enriched sub-test, the contrast by pace of study was not significant.

Contrasts by the approach to mathematics (standard vs. contemporary) yielded significant differences only on the three sub-tests derived from the courses of study of the three contemporary, accelerated programs (UICSM-7, UICSM-8 and SMSG-Accelerated). In each case, the significant difference favored the contemporary program cluster.

When the 38 significant contrasts between program means were considered, UICSM-7 exceeded other programs 16 times and fell below in only 4 comparisons; Standard Enriched, on the other hand, did better only once, and less well 12 times. SMSG-Normal and SMSG-Accelerated exceeded contrasting programs 6 times. The former scored lower in 4 contrasts, the latter in 3. Standard Accelerated scored higher 6 times, lower 10 times while UICSM-8, which only figured in eight significant contrasts, exceeded the comparison program three times, and fell below 5 times. On the basis of these observations the UICSM-7 program was most apt to score significantly above all others while Standard Enriched was most apt to score below the contrasting program. The other four programs showed mixed patterns, with the two SMSG programs somewhat more apt to be higher than lower, while UICSM-8 and Standard Accelerated more apt to score below than above contrasted programs.

Intercorrelations Among Sub-tests. The extent of independence of the six sub-tests can be seen from Table D-9 in Appendix D. The lowest correlation (.0093) was between the sub-test derived from the Standard Accelerated program which studied geometry and the SMSG-Normal program which dealt with contemporary elementary algebra. The highest correlation (.4388) was between the two geometry sub-tests -- II (Standard Accelerated) and VI (UICSM-7). Sub-test II and IV (SMSG-Accelerated) had a correlation of .3870 and IV correlated .3568 with VI. There was apparently more common material among these three sub-tests than among any of the others. The average of the fifteen correlations was approximately .20 which, while significantly different from zero is, nonetheless, small; accounting for about 4% of the variance.

It is interesting to note that the lowest correlations (an average of about .13) were with Sub-test III (SMSG-Normal), while the average correlation with Sub-test VI (UICSM-7) was about twice as great (.26). The intercorrelations among the four contemporary sub-tests were, generally, smaller (about .19) than those between the contemporary and the standard sub-tests (about .26), while the two standard programs had a correlation just under .13. The four sub-tests based on the content of the accelerated programs had an average correlation of .27 while the sub-tests developed from the two enriched programs had a correlation of .18.

The relationships between the sub-tests and the seven independent variables were small. Mathematical ability, as measured by the STEP Test showed consistently higher correlations with the sub-tests than any other of the independent variables. But End of Grade Six Mathematics scores showed a variable relationship to the several sub-tests. The correlation of STEP Math with the Standard Accelerated sub-test was .32; with UICSM-7, .29;

with UICSM-8, 28; with SMSG-Accelerated, .26; with SMSG-Normal, .19; and with Standard Enriched, .17. Thus, 6th grade mathematical ability appeared to explain a somewhat larger portion of the variance of the sub-tests designed for the accelerated programs than of those designed for the enriched programs.

Within Program Analyses.

For each of the ETS tests and for the Teacher-Made Tests analyses were performed by classes within each program to determine the degree to which classes differed in their developed mathematical ability, their cross-program achievement and their achievement on tests specific to their program.

ETS-I - Raw Scores. The spread of class scores varied considerably from program to program, but the within group variances were fairly consistent, ranging from a high of 19 to a low of 15. The variance attributable to class differences, however, ranged from 81 in the UICSM-7 program to 17 in the Standard Accelerated. Each of these two programs was composed of five classes. (See Tables 5-11 to 5-16, and 5-11a to 5-16a).

The maximum discrepancy between class means ranged from 2.3 and 2.4 in Standard Accelerated and SMSG-Accelerated, respectively, to 4.2 in each of the UICSM programs. For Standard Enriched the difference between highest and lowest class mean was 4.0; for SMSG-Normal it was 3.9. In no program did the maximum class difference exceed the difference between highest and lowest program means (See Table 5-3).

Four of the six analyses of variance across classes within programs yielded significant F ratios: Standard Enriched, SMSG-Normal and both UICSM's. In general, classroom variability was considerably lower than had been observed in grade eight.

ETS-I Residual Scores. When the residual scores were analysed (See Tables 5-17 to 5-22 and 5-17a to 5-22a) intra-program class variability was

Table 5-11

Means, Ranks and Standard Deviations of ETS-I Raw Scores
for Classes in the Standard Enriched Program
at the End of Grade Nine

Class	Mean	Rank	S.D.
1	17.39	10	4.48
2	14.86	6	4.64
3	14.42	2	4.73
4	16.54	9	4.59
5	13.44	1	3.50
6	16.43	8	5.21
7	17.48	11	4.69
8	14.77	5	3.62
9	15.84	7	3.72
10	14.53	3	3.89
11	14.70	4	2.58
Total	15.39	--	4.29

Table 5-11a

Analysis of Variance of ETS-I Raw Scores
for Classes in the Standard Enriched Program
at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	414.30	10	41.43	2.25 [a]
Within Groups	4745.50	258	18.40	
TOTAL	5159.80	268		

[a] Significant at the .05 level

Table 5-12

Means, Ranks and Standard Deviations of ETS-I Raw Scores for Classes in the Standard Accelerated Program [a] at the End of Grade Nine

Class	Mean	Rank	S.D.
1	16.86	4	4.16
2	16.30	2	3.57
3	15.95	1	3.04
4	16.82	3	5.05
5	18.29	5	3.58
Total	16.85	--	3.96

[a] The class which followed an algebra sequence was excluded.

Table 5-12a

Analysis of Variance of ETS-I Raw Scores for Classes in the Standard Accelerated Program at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	66.28	4	16.57	1.06
Within Groups	1565.28	100	15.65	
TOTAL	1631.56	104		

Table 5-13

Means, Ranks and Standard Deviations of ETS-I Raw Scores for Classes in the SMSG - Normal Program at the End of Grade Nine

Class	Mean	Rank	S.D.
1	18.85	4	4.18
2	18.59	2	4.17
3	15.36	1	3.53
4	19.33	5	3.39
5	18.76	3	4.40
Total	18.25	--	3.91

Table 5-13a

Analysis of Variance of ETS-I Raw Scores for Classes in the SMSG - Normal Program at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	234.14	4	58.53	3.82 [a]
Within Groups	1668.99	109	15.31	
TOTAL	1903.13	113		

[a] Significant at or beyond the .05 level

Table 5-14

Means, Ranks and Standard Deviations of ETS-I Raw Scores for Classes in the SMSG - Accelerated Program at the End of Grade Nine

Class	Mean	Rank	S.D.
1	20.34	3	3.52
2	19.80	2	4.76
3	20.52	4	4.25
4	18.07	1	4.87
Total	19.58	--	4.38

Table 5-14a

Analysis of Variance of ETS-I Raw Scores for Classes in the SMSG - Accelerated Program at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	91.80	3	30.60	1.60
Within Groups	1706.85	89	19.18	
TOTAL	1798.65	92		

Table 5-15

Means, Ranks and Standard Deviations of ETS-I Raw Scores for Classes in the UICSM-8 Program at the End of Grade Nine

Class	Mean	Rank	S.D.
1	17.80	3	4.44
2	14.76	1	3.59
3	18.95	6	4.94
4	18.45	4	3.20
5	17.47	2	3.66
6	18.68	5	3.45
Total	17.69	--	3.89

Table 5-15a

Analysis of Variance of ETS-I Raw Scores for Classes in the UICSM-8 Program at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	249.25	5	49.85	3.29 [a]
Within Groups	2061.12	136	15.16	
TOTAL	2310.37	141		

[a] Significant at or beyond the .05 level

Table 5-16

Means, Ranks and Standard Deviations of ETS-I Raw Scores for Classes in the UICSM-7 Program at the End of Grade Nine

Class	Mean	Rank	S.D.
1	15.09	2	3.39
2	18.96	5	3.56
3	14.75	1	4.37
4	18.15	4	3.88
5	17.04	3	4.05
Total	16.84	--	3.88

Table 5-16a

Analysis of Variance of ETS-I Raw Scores for Classes in the UICSM-7 Program at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	322.35	4	80.59	5.36 [a]
Within Groups	1727.64	115	15.02	
TOTAL	2049.99	119		

[a] Significant at or beyond the .05 level

Table 5-17

Means, Ranks and Standard Deviations of ETS-I Residual Scores for Classes in the Standard Enriched Program at the End of Grade Nine

Class	Mean	Rank	S.D.
1	1.3178	11	4.44
2	0.7206	10	3.74
3	-1.0771	4	3.63
4	-0.2593	7	3.54
5	-2.5712	1	2.88
6	-0.7569	6	4.50
7	0.3680	9	4.00
8	-1.4706	2	3.43
9	-0.0476	8	3.56
10	-1.3403	3	3.48
11	-0.8042	5	2.32
Total	-0.524	--	3.66

Table 5-17a

Analysis of Variance of ETS-I Residual Scores for Classes in the Standard Enriched Program at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	307.42	10	30.74	2.30 [a]
Within Groups	3450.31	258	13.37	
TOTAL	3757.73	268		

[a] Significant at or beyond the .05 level

Table 5-18

Means, Ranks and Standard Deviations of ETS-1 Residual Scores for Classes in the Standard Accelerated Program at the End of Grade Nine

Class	Mean	Rank	S.D.
1	-1.0492	3	3.76
2	-1.0862	2	3.68
3	-2.3515	1	3.53
4	-0.3801	5	2.88
5	-0.5744	4	3.11
Total	-1.066	--	3.40

Table 5-18a

Analysis of Variance of ETS-I Residual Scores for Classes in the Standard Accelerated Program at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	52.43	4	13.11	1.13
Within Groups	1156.00	100	11.56	
TOTAL	1208.43	104		

Table 5-19

Means, Ranks and Standard Deviations of ETS-I Residual Scores
for Classes in the SMSG - Normal Program
at the End of Grade Nine

Class	Mean	Rank	S.D.
1	1.0854	4	3.62
2	1.5703	5	3.21
3	-1.2380	1	3.34
4	0.2964	3	2.71
5	0.0866	2	3.71
Total	0.282	--	3.31

Table 5-19a

Analysis of Variance of ETS-I Residual Scores
for Classes in the SMSG - Normal Program
at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	92.92	4	23.23	2.12
Within Groups	1191.75	109	10.93	
TOTAL	1287.67	113		

Table 5-20

Means, Ranks and Standard Deviations of ETS-I Residual Scores
for Classes in the SMSG - Accelerated Program
at the End of Grade Nine

Class	Mean	Rank	S.D.
1	2.1736	4	3.78
2	1.4779	3	3.98
3	1.4129	2	4.21
4	0.4961	1	4.03
Total	1.365	--	4.00

Table 5-20a

Analysis of Variance of ETS-I Residual Scores
for Classes in the SMSG - Accelerated Program
at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	37.03	3	12.35	0.77
Within Groups	1420.90	89	15.97	
TOTAL	1457.93	92		

Table 5-21

Means, Ranks and Standard Deviations of ETS-I Residual Scores
for Classes in the UICSM-8 Program
at the End of Grade Nine

Class	Mean	Rank	S.D.
1	0.1111	2	3.46
2	-0.1196	1	3.07
3	1.2754	5	3.87
4	1.4900	6	3.16
5	0.7364	3	3.47
6	1.2167	4	2.97
Total	0.773	--	3.34

Table 5-21a

Analysis of Variance of ETS-I Residual Scores
for Classes in the UICSM-8 Program
at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	48.75	5	9.75	0.87
Within Groups	1517.59	136	11.16	
TOTAL	1566.34	141		

Table 5-22

Means, Ranks and Standard Deviations of ETS-I Residual Scores for Classes in the UICSM-7 Program at the End of Grade Nine

Class	Mean	Rank	S.D.
1	-0.8359	2	2.75
2	0.6786	5	2.62
3	-2.0533	1	3.50
4	0.6082	4	3.52
5	-0.0690	3	3.67
Total	-0.310	--	3.26

Table 5-22a

Analysis of Variance of ETS-I Residual Scores for Classes in the UICSM-7 Program at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	125.67	4	31.42	2.95 [a]
Within Groups	1223.09	115	10.64	
TOTAL	1348.76	119		

[a] Significant at or beyond the .05 level.

considerably reduced. Only two of the six analyses of variance (Standard Accelerated and UICSM-7) yielded significant F ratios, and, in both cases, they were minimal. The difference between highest and lowest class means decreased somewhat, ranging from 3.8 in the Standard Enriched program to 1.4 in the UICSM-8 program. Regression, apparently, tended to decrease inter-class differences most in the two UICSM programs, especially UICSM-8, and least in Standard Enriched. In general, when individual differences were partially controlled, classes within programs differed minimally. The differences observed in earlier years were considerably greater, suggesting that the effects of the teacher, class interaction or other variables not controlled in this study had less influence on pupil performance in grade nine than they had exerted earlier.

ETS-II - Raw Scores. Scores on the Mathematics Achievement Test (ETS-II) varied somewhat more from class to class within programs than did the scores on the Developed Mathematical Abilities Test (ETS-I). The greatest high-low class mean difference (4.6) was observed in the SMSG-Accelerated program; the smallest (3.1) in the SMSG-Normal program. In no case were the differences between highest and lowest class within a program as great as the difference between highest and lowest program, a difference of 7.6. The variances among classes ranged from 129.1 in the SMSG-Accelerated program where the within group variance was also the highest (21.6) to 37.2 in the Standard Enriched, where the within group variance was also the lowest (12.2). (See Tables 5-23 - 5-28).

All six of the within program analyses of variance yielded significant F ratios. (See Tables 5-23a - 5-28a.)

ETS-II - Residual Scores. When individual pupil differences were partially controlled, inter-class variability decreased considerably in the four contem-

Table 5-23

Means, Ranks and Standard Deviations of ETS-II Raw Scores for Classes in the Standard Enriched Program at the End of Grade Nine

Class	Mean	Rank	S.D.
1	14.00	11	3.36
2	12.14	6	3.16
3	12.47	7	3.02
4	13.36	10	3.26
5	12.93	9	3.78
6	9.91	1	3.72
7	12.56	8	4.45
8	11.23	5	3.64
9	11.21	4	3.58
10	11.06	3	3.94
11	10.40	2	2.37
Total	12.07	--	3.50

Table 5-23a

Analysis of Variance of ETS-II Raw Scores for Classes in the Standard Enriched Program at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	371.71	10	37.17	3.04 [a]
Within Groups	3157.95	258	12.24	
TOTAL	3529.66	268		

[a] Significant at or beyond the .05 level

Table 5-24

Means, Ranks and Standard Deviations of ETS-II Raw Scores for Classes in the Standard Accelerated Program [a] at the End of Grade Nine

Class	Mean	Rank	S.D.
1	17.33	4	4.85
2	15.15	2	4.04
3	14.71	1	3.05
4	18.00	5	3.90
5	17.05	3	4.40
Total	16.48	--	4.09

[a] The Class which followed an algebra sequence was excluded

Table 5-24a

Analysis of Variance of ETS-II Raw Scores for Classes in the Standard Accelerated Program at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	173.74	4	43.43	2.60 [a]
Within Groups	1674.46	100	16.75	
TOTAL	1848.20	104		

[a] Significant at or beyond the .05 level

Table 5-25

Means, Ranks and Standard Deviations of ETS-II Raw Scores for Classes in the SMSG - Normal Program at the End of Grade Nine

Class	Mean	Rank	S.D.
1	16.65	3	3.72
2	14.18	1	4.41
3	15.23	2	3.82
4	17.83	5	5.03
5	17.28	4	3.26
Total	16.46	--	4.14

Table 5-25a

Analysis of Variance of ETS-II Raw Scores for Classes in the SMSG - Normal Program at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	196.19	4	49.05	2.86 [a]
Within Groups	1868.10	109	17.14	
TOTAL	2064.29	113		

[a] Significant at or beyond the .05 level

Table 5-26

Means, Ranks and Standard Deviations of ETS-II Raw Scores for Classes in the SMSG - Accelerated Program at the End of Grade Nine

Class	Mean	Rank	S.D.
1	19.12	2	4.19
2	19.20	3	5.13
3	19.29	4	4.41
4	14.70	1	4.87
Total	17.89	--	4.65

Table 5-26a

Analysis of Variance of ETS-II Raw Scores for Classes in the SMSG - Accelerated Program at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	387.17	3	129.06	5.97 [a]
Within Groups	1923.76	89	21.62	
TOTAL	2310.93	92		

[a] Significant at or beyond the .05 level

Table 5- 27

Means, Ranks and Standard Deviations of ETS-II Raw Scores
for Classes in the UICSM-8 Program
at the End of Grade Nine

Class	Mean	Rank	S.D.
1	14.88	3	3.96
2	10.67	1	3.10
3	16.37	6	3.83
4	14.50	2	4.93
5	15.83	5	5.11
6	15.80	4	4.50
Total	14.76	--	4.36

Table 5-27a

Analysis of Variance of ETS-II Raw Scores
for Classes in the UICSM-8 Program
at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	464.47	5	92.89	4.88 [a]
Within Groups	2587.40	136	19.03	
TOTAL	3051.87	141		

[a] Significant at or beyond the .05 level

Table 5-28

Means, Ranks and Standard Deviations of ETS-II Raw Scores
for Classes in the UICSM-7 Program
at the End of Grade Nine

Class	Mean	Rank	S.D.
1	19.73	3	3.47
2	20.87	4	4.86
3	17.50	1	4.85
4	21.30	5	4.40
5	18.75	2	4.32
Total	19.66	--	4.42

Table 5-28a

Analysis of Variance of ETS-II Raw Scores
for Classes in the UICSM-7 Program
at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	237.89	4	59.47	3.05 [a]
Within Groups	2243.10	115	19.51	
TOTAL	2480.99	119		

[a] Significant at or beyond the .05 level

porary programs, increased in the Standard Enriched and remained virtually unchanged in the Standard Accelerated. (See Tables 5-29 -5-34 and 5-29a -5-34a.) Differences between highest and lowest class means followed a similar pattern. It appeared as if controlling for a sizable portion of pupil variability increased the effects of teacher and classroom factors in the Standard Enriched program but decreased them in the contemporary programs. Within group variability remained unchanged in the Standard Enriched program, but as expected, decreased in the five other programs.

Of the six within program analyses of variance, only three yielded significant <u>F</u> ratios. SMSG-Normal and the two UICSM programs did not demonstrate any significant inter-class differences.

At the end of grade nine the range of class achievement within programs as measured by <u>ETS-II</u>, was generally smaller than it had been in the prior years. It is possible that all of the teachers became more comfortable in teaching the material or that teachers who teach ninth grade mathematics, whether in the junior high school or in the senior high school, are more uniformly competent than those assigned to the lower junior high school grades.

<u>Relationship Between Raw and Residual Class Means on Each of the ETS Tests.</u> The degree to which class rank was affected by partially controlling for individual pupil differences varied considerably from program to program and from one test to the other (See Table 5-35). Regression of <u>ETS-I</u> raw scores had the greatest effect on class rank order in the SMSG-Accelerated program and no effect whatever in the UICSM-7 program. The rank order corrlations

Table 5-29

Means, Ranks and Standard Deviations of ETS-II Residual Scores for Classes in the Standard Enriched Program at the End of Grade Nine

Class	Mean	Rank	S.D.
1	-0.1920	11	3.75
2	-.3436	10	3.62
3	-1.3553	7	2.73
4	-0.7057	9	3.22
5	-1.2586	8	3.26
6	-5.4446	1	4.07
7	-2.9291	6	3.91
8	-3.4462	3	3.74
9	-2.9853	4	3.50
10	-2.9690	5	3.70
11	-3.4490	2	3.20
Total	-2.108	--	3.50

Table 5-29a

Analysis of Variance of ETS-II Residual Scores for Classes in the Standard Enriched Program at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	645.02	10	64.50	5.27 [a]
Within Groups	3155.06	258	12.23	
TOTAL	3800.08	268		

[a] Significant at or beyond the .05 level

Table 5-30

Means, Ranks and Standard Deviations of ETS-II Residual Scores for Classes in the Standard Accelerated Program at the End of Grade Nine

Class	Mean	Rank	S.D.
1	1.2034	4	4.37
2	-0.5327	2	3.96
3	-1.8204	1	[illegible].86
4	1.6793	5	3.42
5	0.1354	3	4.46
Total	0.154	--	3.86

Table 5-30a

Analysis of Variance of ETS-II Residual Scores for Classes in the Standard Accelerated Program at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	165.62	4	41.41	2.78 [a]
Within Groups	1488.47	100	14.88	
TOTAL	1654.09	104		

[a] Significant at or beyond the .05 level

Table 5-31

Means, Ranks and Standard Deviations of ETS-II Residual Scores
for Classes in the SMSG - Normal Program
at the End of Grade Nine

Class	Mean	Rank	S.D.
1	0.4172	3	3.15
2	-1.1859	1	3.57
3	0.0962	2	2.94
4	0.5378	5	4.90
5	0.4351	4	3.28
Total	0.151	--	3.74

Table 5-31a

Analysis of Variance of ETS-II Residual Scores
for Classes in the SMSG - Normal Program
at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	38.38	4	9.59	0.68
Within Groups	1527.76	109	14.02	
TOTAL	1566.14	113		

Table 5-32

Means, Ranks and Standard Deviations of ETS-II Residual Scores for Classes in the SMSG - Accelerated Program at the End of Grade Nine

Class	Mean	Rank	S.D.
1	2.5559	4	4.09
2	2.5069	3	4.32
3	1.7706	2	4.31
4	-1.1069	1	3.61
Total	1.304	--	4.06

Table 5-32a

Analysis of Variance of ETS-II Residual Scores for Classes in the SMSG -Accelerated Program at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	229.64	3	76.55	4.64 [a]
Within Groups	1467.65	89	16.49	
TOTAL	1697.29	92		

[a] Significant at or beyond the .05 level

Table 5-33

Means, Ranks and Standard Deviations of ETS-II Residual Scores
for Classes in the UICSM-8 Program
at the end of Grade Nine

Class	Mean	Rank	S.D.
1	-1.2361	2	3.15
2	-2.7241	1	3.30
3	0.0884	5	3.57
4	-0.9184	3	4.78
5	0.4711	6	4.82
6	0.0058	4	3.88
Total	-0.650	--	4.02

Table 5-33a

Analysis of Variance of ETS-II Residual Scores
for Classes in the UICSM-8 Program
at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	159.34	5	31.87	1.97
Within Groups	2200.14	136	16.18	
TOTAL	2359.48	141		

Table 5-34

Means, Ranks and Standard Deviations of ETS-II Residual Scores
for Classes in the UICSM-7 Program
at the End of Grade Nine

Class	Mean	Rank	S.D.
1	5.2243	5	3.60
2	4.1309	3	4.36
3	2.2523	1	4.21
4	5.1556	4	3.64
5	3.3706	2	3.96
Total	4.034	--	3.96

Table 5-34a

Analysis of Variance of ETS-II Residual Scores
for Classes in the UICSM-7 Program
at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	152.09	4	38.02	2.43
Within Groups	1802.46	115	15.67	
TOTAL	1954.55	119		

Table 5-35

Rank Order Correlations of Raw with Residual Class Means for Classes in Six Mathematics Programs on ETS-I and on ETS-II at the End of Grade Nine

	Test				
	ETS-I			ETS-II	
Program	N	Σd^2	R	Σd^2	R
1 Standard Enriched	11	44	.80	30	.86
2 Standard Accelerated	5	6	.70	0	1.00
3 SMSG-Normal	5	14	.60	0	1.00
4 SMSG-Accelerated	4	7	.30	8	.20
5 UICSM-8	6	8	.77	4	.88
6 UICSM-7	5	0	1.00	6	.70

for these two programs were .30 and 1.00, respectively. For the remaining four programs, correlations ranged from .60 to .80.

Since the multiple R derived from the regression equations was somewhat larger for ETS-I (R= .5626) than for ETS-II (R= .4716), the seven independent variables accounted for more of the variance of developed mathematical ability scores than of cross-content achievement scores. (See Table D-1, Appendix D). It would, therefore, be expected that regression of ETS-I scores would be more apt to raise or lower class status than regression of ETS-II scores and rank order correlations would thus be greater on ETS-II. This expectation was only partially confirmed. The mean correlation on ETS-I was .69, on ETS-II it was .77. However, only four of the programs exhibited higher rank order correlations on ETS-II. The two programs which had the highest and lowest ETS-I rank order correlations showed lower correlations on ETS-II. SMSG-Accelerated went down from .30 to .20; UICSM-7 dropped from 1.00 to .70.

It would appear that the high or low achievement of classes in the SMSG-Accelerated program was more dependent upon variations in pupil ability than may have been true for the other programs.

Relationship Between ETS-I and ETS-II Class Means. Rank order correlations between ETS-I and ETS-II raw score class means, by program, varied from .26 for Standard Enriched to .80 for each of the SMSG programs and UICSM-7. Standard Accelerated and UICSM-8 had correlations of .60. (See Table 5-36.)

Table 5-36

Rank Order Correlations Between ETS-I and ETS-II Class Means (Raw and Residual) for Classes in the Six Mathematics Programs at the End of Grade Nine

	Scores				
	Raw			Residual	
Program	N	Σd^2	R	Σd^2	R
1 Standard Enriched	11	162	.26	126	.43
2 Standard Accelerated	5	8	.60	2	.90
3 SMSG-Normal	5	4	.80	26	-.30
4 SMSG-Accelerated	4	2	.80	0	1.00
5 UICSM-8	6	15	.60	18	.49
6 UICSM-7	5	4	.80	14	.30

In three of the four contemporary programs classes which showed a relatively high level of developed mathematical ability generally also scored high on cross-content achievement and vice versa. In the Standard Enriched program however, there was far less relationship between class means on the two tests. When the scores were regressed on the seven independent variables, rank-order correlations decreased markedly in SMSG-Normal and UICSM-7 and to a lesser degree in UICSM-8. But for Standard Enriched, Standard Accelerated and SMSG-Accelerated, correlations increased. The mean rank order correlation between the two ETS tests on raw scores was approximately .58, on residuals, about .45.

Teacher-Made Tests (TMT). The tests constructed by the teachers and consultants were intended to measure the content covered by the several classes in each of the programs. Since the instructions to teachers of accelerated courses was to "go as fast and as far as the class appears capable of going," there was considerable variability of coverage from class to class. Thus, the TMT's represented each teacher group's best estimate of the common learnings expected of the pupils in each program.

Regressions of the TMT scores on the seven independent variables were performed separately for each program. (See Table D-3 in Appendix D). On the average, the seven independent variables accounted for about 30% of the variance of the TMT's, ranging from 16% in Standard Accelerated to 37% in UICSM-7.

TMT - Raw Scores. Each of the TMT's contained 25 items, allowing for a maximum score of 25. However, mean program scores varied considerably going from about 13 on the Standard Accelerated and the SMSG-Accelerated TMT's to about 18 on the Standard Enriched and UICSM-7 TMT's. SMSG-Normal and UICSM-8 had mean scores of about 16 and 14, respectively. The range of pupil scores within classes was considerable in each of the programs with lowest individual scores ranging from 3 to 8 and highest scores from 21 to 25. (See Tables 5-37 - 5-42.) It would appear that some of the tests expected more of the pupils than did others. It was on the Standard-and the SMSG-Accelerated programs, in which pupils were actually accelerated through content (as opposed to beginning earlier and then following a normal pace as in the UICSM programs) that pupils fell furthest below teacher expectations, while in the Standard Enriched and UICSM-7 programs, pupils appeared to be about 20% more successful in meeting teacher expectations.

Analyses of variance across classes within each program yielded significant _F_ ratios in all cases except UICSM-7. (See Tables 5-37a - 5-42a.) Variances among class means ranged from 20 in UICSM-7 to 133 in SMSG-Accelerated. The other four programs fell between 34 and 58. Pupil variability tended to be relatively comparable across programs ranging from about 10 in the Standard Accelerated program to approximately 15 in UICSM-8.

Although all of the teachers participated in constructing the program test, some classes appeared to have learned what the teachers believed they had covered considerably better than others. For example, in the SMSG-Accelerated program the lowest scoring class passed, on the average, about 44% of the items while the highest scoring class passed, on the average, about 66%, a discrepancy of 22%.

In UICSM-7, on the other hand, the discrepancy in the average percent of items passed between highest and lowest scoring class was only 9%.

TMT - Residual Scores. When the _TMT_ scores were controlled for individual pupil differences in ability and attitudes toward mathematics, inter-class variability decreased substantially in all but the UICSM-7 program where a slight increase was evidenced. Within group variances decreased slightly in the two UICSM programs, remained unchanged in Standard Enriched and SMSG-Normal, and showed a slight increase in Standard Accelerated and SMSG- Accelerated. (See Tables 5-37 - 5-42.)

Within program analyses of variance of residual scores yielded only one significant _F_ ratio. Thus, the significant differences in classroom performance noted on the raw scores, largely disappeared when pupil ability was held

Table 5-37

Means, Ranks, Standard Deviations and Ranges [a]
of Teacher-Made Test (TMT) Raw and Residual Scores
for Classes in the Standard Enriched Program at the End of Grade Nine

	Raw Scores				Residuals		
Class	Mean	Rank	S.D.	Range	Mean	Rank	S.D.
1	20.26	11	3.19	17-24	1.65	11	4.39
2	16.48	1	3.94	8-23	0.87	9	3.76
3	18.53	6	2.81	13-24	-0.58	4	3.66
4	18.07	5	4.51	9-25	0.16	7	3.55
5	18.56	7	3.39	12-24	-2.11	1	2.80
6	19.04	9	4.08	9-24	-0.20	5	4.52
7	19.70	10	3.47	7-24	1.24	10	3.85
8	16.73	2	4.38	7-23	-0.63	3	3.19
9	18.74	8	3.18	13-23	0.51	8	3.66
10	17.00	4	3.59	9-24	-0.76	2	3.53
11	16.95	3	2.84	13-22	-0.16	6	2.26
Total	18.24		3.62	7-25	0.00		3.63

[a] Ranges reported only for raw scores.

Table 5-37a

Analysis of Variance of TMT Raw Scores
for Classes in the Standard Enriched Program
at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	374.01	10	37.40	2.85 [a]
Within Groups	3382.76	258	13.11	
TOTAL	3756.77	268		

[a] Significant at or beyond the .05 level.

Table 5-37b

Analysis of Variance of TMT Residual Scores
for Classes in the Standard Enriched Program
at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	282.77	10	28.27	2.15 [a]
Within Groups	3396.79	258	13.14	
TOTAL	3679.56	268		

[a] Significant at or beyond the .05 level.

Table 5-38

Means, Ranks, Standard Deviations and Ranges of Teacher-Made Test (TMT) Raw and Residual Scores for Classes in the Standard Accelerated Program [a] at the End of Grade Nine

Class	Raw Scores Mean	Rank	S.D.	Range [b]	Residuals Mean	Rank	S.D.
1	14.62	5	2.65	9-19	-0.20	3	3.92
2	13.80	4	3.05	6-21	-0.47	2	3.46
3	11.48	1	1.66	8-15	-1.62	1	3.27
4	13.18	3	4.16	4-19	0.29	4	2.80
5	12.05	2	3.87	3-17	0.46	5	3.21
Total	13.02		3.22	3-21	-0.30		3.35

[a] This table includes only those classes which followed the geometry sequence.

[b] Ranges reported only for raw scores.

Table 5-38a

Analysis of Variance of TMT Raw Scores for Classes in the Standard Accelerated Program at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	136.35	4	34.09	3.29 [a]
Within Groups	1035.62	100	10.36	
TOTAL	1171.97	104		

[a] Significant at or beyond the .05 level

Table 5-38b

Analysis of Variance of TMT Residual Scores for Classes in the Standard Accelerated Program at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	57.35	4	14.34	1.28
Within Groups	1120.51	100	11.21	
TOTAL	1177.36	104		

Table 5-39

Means, Ranks, Standard Deviations and Ranges of Teacher-Made Test (TMT) Raw and Residual Scores for Classes in the SMSG-Normal Program at the End of Grade Nine

Class	Raw Scores Mean	Rank	S.D.	Range [a]	Residuals Mean	Rank	S.D.
1	16.10	4	3.58	12-24	1.03	5	3.70
2	14.35	2	3.60	8-21	1.00	4	3.07
3	13.64	1	3.27	8-20	-1.22	1	3.29
4	17.57	5	2.47	11-22	-0.13	3	2.77
5	15.56	3	3.82	10-23	-0.28	2	3.44
Total	15.65		3.31	8-24	0.00		3.24

[a] Ranges reported only for raw scores.

Table 5-39a

Analysis of Variance of TMT Raw Scores for Classes in the SMSG-Normal Program at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	232.35	4	58.09	5.25 [a]
Within Groups	1216.31	109	11.06	
TOTAL	1448.66	113		

[a] Significant at or beyond the .05 level

Table 5-39b

Analysis of Variance of TMT Residual Scores for Classes in the SMSG-Normal Program at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	73.16	4	18.29	1.74
Within Groups	1144.98	109	10.50	
TOTAL	1218.14	113		

Teble 5-40

Means, Ranks, Standard Deviations and Ranges of Teacher-Made Test (TMT) Raw and Residual Scores for Classes in the SMSG-Accelerated Program at the End of Grade Nine

Class	Raw Scores Mean	Rank	S.D.	Range [a]	Residuals Mean	Rank	S.D.
1	12.80	2	3.62	7-19	0.60	4	3.11
2	14.65	3	2.89	10-18	-0.29	2	4.18
3	16.52	4	4.32	7-22	0.18	3	3.98
4	11.00	1	3.01	5-17	-0.48	1	3.92
Total	13.55		3.52	5-22	0.00		3.79

[a] Ranges reported only for raw scores

Table 5-40a

Analysis of Variance of TMT Raw Scores for Classes in the SMSG-Accelerated Program at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	399.44	3	133.14	10.95 [a]
Within Groups	1081.79	89	12.15	
TOTAL	1481.23	92		

[a] Significant at or beyond the .05 level

Table 5-40b

Analysis of Variance of TMT Residual Scores for Classes in the SMSG-Accelerated Program at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	17.45	3	5.82	0.40
Within Groups	1280.91	89	14.39	
TOTAL	1298.36	92		

Table 5-41

Means, Ranks, Standard Deviations and Ranges of Teacher-Made Test (TMT) Raw and Residual Scores for Classes in the UICSM-8 Program at the End of Grade Nine

Class	Raw Scores Mean	Rank	S.D.	Range [a]	Residuals Mean	Rank	S.D.
1	15.52	5.5	2.79	9-21	-0.64	2	3.32
2	11.95	1	4.54	4-20	-0.95	1	3.18
3	13.90	3	3.86	8-22	0.69	5	3.77
4	14.00	4	2.61	8-18	0.82	6	3.20
5	13.27	2	3.81	9-23	-0.03	3	3.48
6	15.52	5.5	4.86	6-24	0.59	4	2.84
Total	14.08		3.83	4-24	0.06		3.30

[a] Ranges reported only for raw scores

Table 5-41a

Analysis od Variance of TMT Raw Scores for Classes in the UICSM-8 Program at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	219.33	5	43.87	2.97 [a]
Within Groups	2007.10	136	14.76	
TOTAL	2226.43	141		

[a] Significant at or beyond the .05 level

Table 5-41b

Analysis of Variance of TMT Residual Scores for Classes in the UICSM-8 Program at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	61.27	5	12.25	1.12
Within Groups	1483.32	136	10.91	
TOTAL	1544.59	141		

Table 5-42

Means, Ranks, Standard Deviations and Ranges
of Teacher-Made Test (TMT) Raw and Residual Scores for Classes
in the UICSM-7 Program at the End of Grade Nine

Class	Raw Scores Mean	Rank	S.D.	Range [a]	Residuals Mean	Rank	S.D.
1	17.09	1	3.19	12-23	-0.42	2	2.80
2	17.52	2	3.91	8-24	0.78	4	2.11
3	17.83	3	3.71	10-25	-1.58	1	3.38
4	19.33	5	3.15	13-25	0.81	5	3.56
5	18.63	4	4.29	9-25	0.31	3	3.78
Total	18.13		3.23	8-25	0.00		3.21

[a] Ranges reported only for raw scores

Table 5-42a

Analysis of Variance of TMT Raw Scores
for Classes in the UICSM-7 Program
at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	79.35	4	19.84	1.47
Within Groups	1548.52	115	13.47	
TOTAL	1627.87	119		

Table 5-42b

Analysis of Variance of TMT Residual Scores
for Classes in the UICSM-7 Program
at the End of Grade Nine

SOURCE OF VARIANCE	SUMS OF SQUARES	d.f.	EST. MEAN SQUARES	F
Among Means	.11	4	24.53	2.38
Within Groups	1184.31	115	10.30	
TOTAL	1282.42	119		

relatively constant. In fact, SMSG-Accelerated, which showed the greatest inter-class variability on the raw score analyses, showed the smallest on the residual scores.

It would appear that at the end of grade nine differences in class performance on the Teacher-Made Tests, even more than performance on the two ETS measures, was a function of the ability level of the pupils in a particular classroom rather than of the teacher or of other intra-class factors.

Relationship Between Raw and Residual TMT Scores. Rank order correlations between raw and residual class means ranged from -.12 for Standard Accelerated to .50 for SMSG-Normal and UICSM-7. In general, correlations were considerably lower in grade nine than they had been in the eighth grade. (See Table 5-43; also see Table 4-41.) This finding further confirms the observations from the analyses of variance that in grade nine, pupil ability within a class was a more important factor in class achievement than were the factors related to the teacher, class atmosphere or other extra-pupil variables.

Table 5-43

Rank Order Correlations Between Raw and Residual Score Means on the Teacher-Made Tests for Classes in Six Mathematics Programs at the End of Grade Nine

	Tests						
	TMT-Raw & Residual			TMT & ETS-II Raw		TMT & ETS-II Res.	
Program	N	Σd^2	R	Σd^2	R	Σd^2	R
1 St. Enr.	11	138	.37	150	.32	136	.39
2 St. Accel.	5	18	-.12	10	.50	6	.70
3 SMSG-Normal	5	10	.50	4	.80	22	-.10
4 SMSG-Accel.	4	6	.40	0	1.00	2	.80
5 UICSM-8	6	23.5	.33	30.5	.13	18	.49
6 UICSM-7	5	10	.50	16	.20	12	.40

Relationship Between ETS-II and TMT's. Rank order correlations of raw ETS-II and TMT scores were also higher than in previous years. The correlations between the class means of the two tests give some indication of the relationship between class achievement on material covered by the class during the year and cross-program material, only one sixth of which was directly related to class work. When raw scores were considered, there was a greater relationship between the two tests in classes in the two SMSG programs, least in the UICSM programs (See Table 5-43), however, rank order correlations among residual class means showed an increase in four of the programs but a drop from .80 to -.10 for SMSG-Normal and a moderate drop from 1.00 to .80 for SMSG-Accelerated. When individual pupil differences were partially controlled, class status on the two achievement measures became less comparable in the SMSG programs, more comparable in the other four.

Attitude Tests

The Questionnaire on Mathematics administered at the beginning of grade seven and, again, at the end of grade nine, was composed of six separate categories. The instrument thus yielded one total score and six sub scores. In addition, a 25 item Abilities Self-Rating scale was administered at both points in time. The scale called for ratings (from 1 high to 5 low) on 25 abilities, one of which was "mathematical ability." The self-rating scale was scored for the 25 items combined as well as for the single item dealing with mathematical ability. The nine separate ninth grade scores derived from the two instruments were examined by analyses of co-variance, in which the seventh grade pre-test scores were the co-variates. Tables D-10 - D-18 in Appendix D present analyses of the seventh grade and the ninth grade scores before correction as well as the program mean corrections. Tables 5-44 - 5-50 present the analyses of the adjusted ninth grade scores.

Questionnaire on Mathematics - Total Score. A one-way analysis of variance of the adjusted program means yielded a significant F ratio indicating, that after controlling for initial seventh grade attitude scores, the program groups differed from each other in their general attitudes toward mathematics, mathematicians and their own mathematical interests and competence. (See Table 5-44 and 5-44a.)

Contrasts among program means found the two UICSM programs significantly lower than the two standard programs. The highest adjusted mean was achieved by Standard Accelerated, the lowest by UICSM-7. The standard vs. contemporary cluster contrast favored the standard. The enriched and accelerated clusters did not differ significantly from each other.

On the adjusted scores of Category I - The Impact of Mathematics on Society - the six programs differed significantly. (See Tables 5-45 and 5-45a.) Contrasts among means found UICSM-7 significantly lower than Standard Accelerated and SMSG-Accelerated. Neither of the cluster contrasts reached significance.

On Category II - Characteristics of Mathematicians - UICSM-7 again had the lowest mean score. (See Table 5-46.) An analysis of variance across the six programs yielded a significant F ratio and contrasts among means found UICSM-7 significantly lower than Standard Accelerated, SMSG-Normal and SMSG-Accelerated. Neither of the cluster analyses reached significance.

Category III - Mathematics as a Career - showed relatively small differences among programs. Although an analysis of variance of adjusted scores yielded a significant F ratio, neither the program nor the cluster contrasts reached significance. (See Tables 5-47 and 5-47a.)

Table 5-44

Adjusted Means [a] and Standard Deviations of Total Attitude Scores for Pupils in Six Mathematics Programs at the End of Grade Nine.

Program	N	$\bar{X}$	S.D.
1. Standard Enriched	266	38.08	9.56
2. Standard Accelerated	130	39.39	8.67
3. SMSG-Normal	113	36.17	9.59
4. SMSG-Accelerated	89	37.60	11.67
5. UICSM-8	156 [b]	34.80	9.31
6. UICSM-7	118	33.72	11.18

[a] Means were adjusted by seventh grade attitude scores. See Appendix D, Table D-10

[b] The UICSM-8 class which followed the incorrect sequence is included.

Table 5-44a

Analysis of Variance of Adjusted Total Attitudes Scores at the End of Grade Nine.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	3087.56	5	617.51	6.35 [a]
Within Groups	84069.91	865	97.19	
Total	87157.47	870		

Scheffé Tests

Program	1	2	3	4	5	6
1					3.28 [a]	4.36 [a]
2					4.59 [a]	5.67 [a]
3						
4						
5						
6						

Standard vs. Contemporary = 3.16 [a]
Enriched vs. Accelerated = n.s.

[a] Significant at or beyond the .05 level.

Table 5-45

Adjusted Means [a] and Standard Deviations of Category I Scores - (Impact of Mathematics on Society) for Pupils in Six Mathematics at the End of Grade Nine.

Program	$\bar{X}$	S.D.
1. Standard Enriched	5.70	1.91
2. Standard Accelerated	5.86	1.67
3. SMSG-Normal	5.18	1.77
4. SMSG-Accelerated	5.88	4.23
5. UICSM-8	5.33	1.89
6. UICSM-7	4.93	1.99

[a] Means were adjusted by Seventh Grade Category I Scores. See Appendix D, Table D-11

Table 5-45a

Analysis of Variance of Adjusted Category I Scores at the End of Grade Nine.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	95.36	5	19.07	3.88 [a]
Within Groups	4253.20	865	4.92	
Total	4348.56	870		

Scheffé Tests

Program	1	2	3	4	5	6
1						
2						0.93 [a]
3						
4						0.95 [a]
5						
6						

Standard vs. Contemporary = n.s.
Enriched vs. Accelerated = n.s.

[a] Significant at or beyond the .05 level.

Table 5-46

Adjusted Means [a] and Standard Deviations of Category II Scores - (Characteristics of Mathematicians) for Pupils in Six Mathematics Programs at the End of Grade Nine.

Program	$\bar{X}$	S.D.
1. Standard Enriched	5.62	2.41
2. Standard Accelerated	6.06	2.18
3. SMSG-Normal	6.11	2.19
4. SMSG-Accelerated	6.01	2.23
5. UICSM-8	5.37	2.51
6. UICSM-7	4.82	2.43

[a] Means were adjusted by seventh grade Category II Scores. See Appendix D, Table D-12.

Table 5-46a

Analysis of Variance of Adjusted Category II Scores at the End of Grade Nine.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	150.41	5	30.08	5.42 [a]
Within Groups	4799.56	865	5.55	
Total	4949.97	870		

Scheffé Tests

Program	1	2	3	4	5	6
1						
2						1.24 [a]
3						1.29 [a]
4						1.19 [a]
5						
6						

Standard vs. Contemporary = n.s.
Enriched vs. Accelerated = n.s.

[a] Significant at or beyond the .05 level.

Table 5-47

Adjusted Means [a] and Standard Deviations of Category III Scores (Mathematics as a Career) for Pupils in Six Mathematics Programs at the End of Grade Nine.

Program	$\bar{X}$	S.D.
1. Standard Enriched	7.84	2.27
2. Standard Accelerated	7.91	2.24
3. SMSG-Normal	7.60	2.29
4. SMSG-Accelerated	8.01	2.57
5. UICSM-8	7.45	2.20
6. UICSM-7	7.20	2.42

[a] Means were adjusted by seventh grade Category III scores. See Appendix D, Table D-13.

Table 5-47a

Analysis of Variance of Adjusted Category III Scores at the End of Grade Nine.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	59.20	5	11.84	2.22 [a]
Within Groups	4608.05	865	5.33	
Total	4667.25	870		

Scheffé Tests

None of the program or cluster contrasts reached significance.

[a] Significant at or beyond the .05 level.

Category IV - Nature of Mathematics - showed considerable differences among programs. (See Table 5-48.) An analysis of variance yielded a significant F-ratio and nine of the contrasts among means reached significance. Standard Enriched, Standard Accelerated, and SMSG-Accelerated each exceeded SMSG-Normal and the two UICSM programs. The standard cluster scored significantly higher than the contemporary, but the enriched and accelerated did not differ significantly from each other. (See Table 5-48a.)

Category V - Self-Appraisal of Mathematical Abilities and Interests - was included as one of the seven independent variables on which the various achievement scores were regressed. As on the other categories, the two UICSM programs scored lower than most of the others. (See Table 5-49.) An analysis of variance across the six programs yielded a significant F ratio. However, only one of the program contrasts reached significance. The Standard Accelerated exceeded UICSM-8. The standard program cluster scored significantly higher than the contemporary but the enriched did not differ significantly from the accelerated. (See Table 5-49a.)

Category VI - School Effectiveness in Teaching Mathematics - showed no significant differences among programs. (See Tables 5-50 and 5-50a.) It appeared that pupils in all of the programs rated their junior high school mathematics instruction about equally.

In general, the analyses did not confirm the expectation that pupils in accelerated programs would demonstrate greater improvement in attitudes toward mathematics than those in enriched programs or that those in contemporary classes would be more favorably disposed toward the subject than those in standard classes. On the contrary, the comparisons which reached significance favored the more traditional programs and, generally, the two UICSM programs showed the least favorable attitudes. This was

Table 5-48

Adjusted Means [a] and Standard Deviations of Category IV Scores - (Nature of Mathematics) for Pupils in Six Mathematics Programs at the End of Grade Nine.

Program	$\bar{X}$	S.D.
1. Standard Enriched	4.90	1.54
2. Standard Accelerated	4.79	1.54
3. SMSG-Normal	4.20	1.64
4. SMSG-Accelerated	4.82	1.72
5. UICSM-8	4.12	1.92
6. UICSM-7	3.78	1.76

[a] Means were adjusted by Seventh Grade Category IV Scores. See Appendix D, Table D-14.

Table 5-48a

Analysis of Variance of Adjusted Category IV Scores at the End of Grade Nine.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	157.00	5	31.40	11.43 [a]
Within Groups	2376.87	865	2.75	
Total	2533.87	870		

Scheffé Tests

Program	1	2	3	4	5	6
1			0.70 [a]		0.78 [a]	1.12 [a]
2			0.59 [a]		0.67 [a]	1.01 [a]
3				-0.62 [a]		
4					0.70 [a]	1.04 [a]
5						

Standard vs. Contemporary = 0.61 [a]
Enriched vs. Accelerated = n.s.

[a] Significant at or beyond the .05 level.

Table 5-49

Adjusted Means [a] and Standard Deviations of Category V Scores - (Self-Appraisal of Mathematical Abilities and Interests) for Pupils in Six Mathematics Programs at the End of Grade Nine.

Program	$\bar{X}$	S.D.
1. Standard Enriched	11.02	4.77
2. Standard Accelerated	11.62	3.98
3. SMSG-Normal	10.06	4.66
4. SMSG-Accelerated	10.94	4.60
5. UICSM-8	9.75	4.62
6. UICSM-7	9.93	4.66

[a] Means were adjusted by seventh grade Category V scores. See Appendix D, Table D-15.

Table 5-49a

Analysis of Variance of Adjusted Category V Scores at the End of Grade Nine.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	377.72	5	75.54	3.60 [a]
Within Groups	18136.01	865	20.97	
Total	18513.73	870		

Scheffé Tests

Program	1	2	3	4	5	6
1						
2					1.87 [a]	
3						
4						
5						
6						

Standard vs. Contemporary = 1.15 [a]
Enriched vs. Accelerated = n.s.

[a] Significant at or beyond the .05 level.

Table 5-50

Adjusted Means[a] and Standard Deviations of Category VI Scores - (School Effectiveness in Teaching Mathematics) for Pupils in Six Mathematics Programs at the End of Grade Nine.

Program	$\bar{X}$	S.D.
1. Standard Enriched	2.99	1.41
2. Standard Accelerated	3.16	1.62
3. SMSG-Normal	2.99	1.57
4. SMSG-Accelerated	3.19	2.10
5. UICSM-8	2.82	1.51
6. UICSM-7	3.08	1.70

[a] Means were adjusted by seventh grade Category VI scores. See Appendix D, Table D-16.

Table 5-50a

Analysis of Variance of Adjusted Category VI Scores at the End of Grade Nine.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	12.06	5	2.41	0.94
Within Groups	2226.32	865	2.57	
Total	2238.38	870		

particularly marked on the total score and on Category II (Characteristics of Mathematicians) and Category IV (Nature of Mathematics). Pace appeared to make no difference.

Abilities Self-Ratings. Pupil self ratings of their academic, task related and personal-social abilities yielded small differences among program means. Although analyses of variance of both total scores (see Tables 5-51 and 5-51a) and scores on mathematics ability (see Tables 5-52 and 5-52a) yielded significant F ratios, neither of the program or cluster contrasts reached significance.

Summary - Attitudes. In general, differences in pace and approach to the teaching of mathematics over a three year period had limited effects on the attitudes or self-assessments of the pupils. Changes from beginning of grade seven to the end of grade nine were generally small and not consistently influenced by a particular program, pace or approach.

Longitudinal Rank Analyses.

To assess the cumulative effects of the several programs on pupil achievement over the three years, longitudinal rank analyses were performed on the residual scores of each of the ETS tests separately and then of both combined. Each of the 868 pupils for whom there was complete data on each of the ETS tests was rank ordered from 1 high to 868 low for each of the three years. Ranks for each individual were added, thus giving each pupil a composite rank score on each test and on the two tests combined. Pupils were then again regrouped into programs and the six programs compared by the following formula:

Table 5-51

Adjusted Means [a] and Standard Deviations of the Total Ability Self Rating Scores [b] for Pupils in Six Mathematics Programs at the End of Grade Nine.

Program	N	$\bar{X}$	S.D.
1. Standard Enriched	265	49.42	10.43
2. Standard Accelerated	130	53.40	9.48
3. SMSG-Normal	113	49.99	10.02
4. SMSG-Accelerated	89	50.88	8.82
5. UICSM-8	156	51.85	10.45
6. UICSM-7	118	50.64	9.87

[a] Means were adjusted by seventh grade self-rating scores. See Appendix D, Table D-17.

[b] Highest possible score = 25; lowest possible score = 125.

Table 5-51a

Analysis of Variance of Adjusted Self-Rating Scores at the End of Grade Nine.

Source of Variance	Sums of Squares	d.f.	Est. Mean Squares	F
Among Means	1631.02	5	326.20	3.26 [a]
Within Groups	86640.11	864	100.28	
Total	88271.13	869		

Scheffé Tests

None of the program or cluster contrasts reached significance.

[a] Significant at or beyond the .05 level.

Table 5-52

Adjusted Means [a] and Standard Deviations of Self-Rating of Ability In Mathematics Scores [b] for Pupils in Six Mathematics Programs at the End of Grade Nine.

	Program	N	$\bar{X}$	S.D.
1.	Standard Enriched	265	2.00	1.03
2.	Standard Accelerated	130	2.10	0.94
3.	SMSG-Normal	113	2.17	0.87
4.	SMSG-Accelerated	89	1.89	0.75
5.	UICSM-6	156	2.28	1.08
6.	UICSM-7	118	2.22	0.94

a Means were adjusted by seventh grade ability in mathematics self-rating. See Appendix D, Table D-18.

b Highest possible score = 1; lowest possible score = 5.

Table 5-52a

Analysis of Variance of Adjusted Self-Rating Scores of Ability in Mathematics at the End of Grade Nine.

Source of Variance	Sum of Squares	d.f.	Est. Mean Squares	F
Among Means	13.22	5	2.64	2.83 [a]
Within Groups	807.59	864	.93	
Total	820.81	869		

Scheffé Tests

None of the program or cluster contrasts reached significance.

a Significant at or beyond the .05 level.

$$\chi^2_{(5)} = \frac{\sum_{i=1}^{6} (T_i^2)/N_i - (9N(N+1)^2/4)}{\left[\sum_{i=1}^{6} \sum_{j=1}^{N_i} (R_{ij} - 3(N+1)/2)^2\right] / N}$$

$$\text{Where } T_i = \sum_{j=1}^{N_i} R_{ij} \quad \text{and } R_{ij} = R_1 + R_2 + R_3$$

Each of the three analyses (ETS-I, ETS-II and both tests combined) yielded a significant χ^2. (See Tables 5-53 - 5-55). Since the ranks went from 1 high to 868 low, the smaller the sum of the ranks, the higher the performance level of the program. The same order was followed in ranking the mean rank on each of the three analyses. In each of the three, SMSG-Accelerated achieved first place, Standard Enriched and Standard Accelerated last and next to last place, respectively. UICSM-8 ranked in second place on ETS-I and on the combined tests; UICSM-7 ranked second on ETS-II, fourth on ETS-I, but third on the two tests combined. SMSG-Normal ranked third on ETS-I and fourth on ETS-II and the two tests combined.

If the two ETS tests are to be given equal weight in measuring pupil achievement, then, on the basis of their composite rank, pupils in SMSG-Accelerated achieved the highest scores over the three years, followed by UICSM-8, UICSM-7, SMSG-Normal, Standard Accelerated and, last, Standard Enriched. On ETS-I, contrasts among mean ranks of the six programs found SMSG-Accelerated and UICSM-8 scoring significantly higher than either of the standard programs. SMSG-Normal scored significantly higher than Standard Enriched. None of the other program contrasts reached significance. Both cluster contrasts were significant: the contemporary exceeded the standard, the accelerated exceeded the enriched.

On ETS-II, the program contrasts found all four contemporary programs significantly higher than each of the standard ones. None of the contemporary

Table 5-53

Rank[a] Analysis of Variance on ETS-I Residual Scores
Sum of Ranks for Grades 7, 8 and 9.

Program	Mean Rank	Rank	χ^2
1	1389.21	6	56.50[b]
2	1363.44	5	
3	1127.55	3	
4	1007.29	1	
5	1082.33	2	
6	1226.91	4	

Program Contrasts

	1	2	3	4	5	6
1 Standard Enriched			261.66[b]	378.00[b]	306.87[b]	
2 Standard Accelerated				352.23[b]	281.10[b]	
3 SMSG-Normal						
4 SMSG-Accelerated						
5 UICSM-8						
6 UICSM-7						

Enriched vs. Accelerated = 137.88[b]

Standard vs. Contemporary = 264.27[b]

---

[a] Scores ranked in descending order.

[b] Significant at or beyond the .05 level.

Table 5-54

Rank [a] Analysis of Variance on ETS-II Residual Scores
Sum of Ranks for Grades 7, 8 and 9

Program	Mean Rank	Rank	χ^2
1	1482.31	6	141.47 [b]
2	1439.50	5	
3	1168.98	4	
4	953.78	1	
5	1061.52	3	
6	978.69	2	

Program Contrasts

	1	2	3	4	5	6
1 Standard Enriched			313.33 [b]	532.45 [b]	420.79 [b]	503.62 [b]
2 Standard Accelerated			270.52 [b]	489.65 [b]	377.99 [b]	460.81 [b]
3 SMSG-Normal						
4 SMSG-Accelerated						
5 UICSM-8						
6 UICSM-7						

Enriched vs. Accelerated = 283.11 [b]

Standard vs. Contemporary = 426.21 [b]

---

[a] Scores ranked in descending order.

[b] Significant at or beyond the .05 level.

Table 5-55

Rank[a] Analysis of Variance on Combined ETS-I and ETS-II Residual Scores
Sum of Ranks for Grades 7, 8, and 9

Program	Mean Rank	Rank	χ^2
1	2871.52	6	1576.30[b]
2	2802.94	5	
3	2296.53	4	
4	1961.07	1	
5	2143.85	2	
6	2205.60	3	

	1	2	3	4	5	6
1 Standard Enriched				910.45[b]	727.66[b]	665.92[b]
2 Standard Accelerated				84[illegible].88[b]		
3 SMSG-Normal						
4 SMSG-Accelerated						
5 UICSM-8						
6 UICSM-7						

Enriched vs. Accelerated = 420.99[b]

Standard vs. Contemporary = 690.48[b]

---

[a] Scores ranked in descending order.

[b] Significant at or beyond the .05 level.

programs differed from each other, nor did the two standard ones differ from each other. Both cluster contrasts reached significance, with the contemporary higher than the standard, the accelerated above the enriched.

On the two tests combined, the three contemporary accelerated programs (SMSG-Accelerated and both UICSM's) ranked significantly higher than Standard Enriched. In addition, SMSG-Accelerated ranked significantly higher than Standard Accelerated. Both program clusters reached significance in the same order as in the single test analyses.

Relationships Between Sub-test Scores ETS-I and the TMT's.

Although the ETS-II sub-tests were directly drawn from the content of each particular program, they apparently sampled different content than was included by the teachers and consultants in developing the end of year Teacher-Made Tests. Correlations between TMT scores and scores on the sub-test specific to each program are not consistently highest. Examination of Table 5-56 shows that the sub-test TMT correlation marked $\overset{b}{\vee}$ were not consistently highest either by row or by column in any one of the three years. At the end of grade 7, the correlation between "own" sub-test and "own" TMT was highest for SMSG-Accelerated, lowest for the majority of the Standard Accelerated group (all but the class which followed an algebra sequence in grade 9). Only the Standard Accelerated class which later took algebra and the SMSG Accelerated program showed a higher correlation between the TMT and its "own" sub-test scores than between their TMT and other sub-tests. In most instances, correlations of "own" sub-test with the program specific teacher made end of year test were no greater than those with the general Developed Mathematical Abilities Test.

Table 5-56

Correlations of Sub-test Scores with ETS-I and TMT Scores for Grades Seven, Eight and Nine For Each of the Seven[a] Mathematics Programs.

Grade Seven

	Sub-tests									
	I		II		III		IV		V	
Programs	ETS-I	TMT	ETS-I	TMT	ETS-I	TMT	ETS-I	TMT	ETS-I	TMT
1. St. Enriched	.35	.37[b]	.31	.25	.33	.44	.40	.16	.31	.17
2. St. Acc.-Geom.	.11	.17	.08	.14[b]	.36	.25	.12	.09	.35	.37
3. St. Acc.-Alg.	.02	.05	.32	.36[b]	.46	.12	.50	.33	.61	.12
4. SMSG-Normal	.45	.37	.45	.38	.33	.32[b]	.23	.17	.39	.35
5. SMSG-Acc.	.22	.18	.38	.36	.29	.20	.39	.40[b]	.31	.34
6. UICSM-8	.53	.45	.40	.57	.44	.39	.25	.22[b]	.45	.44
7. UICSM-7	.31	.23	.31	.37	.37	.36	.31	.25	.28	.33[b]
Total	.42	.25	.35	.34	.44	.32	.38	.15	.42	.20

Grade Eight

	Sub-tests											
	I		II		III		IV		V		VI	
Pro.	ETS-I	TMT	ETS-I	TMT	ETS-I	TMT	ETS-I	TMT	ETS-I	TMT	ETS-I	TMT
1.	.41	.30[b]	.15	.12	.28	.23	.24	.18	.15	.05	.32	.23
2.	.36	.25	.37	.47[b]	.09	.14	.15	.13	.21	.08	.10	.27
3.	.02	.02	.48	.51[b]	.35	.20	.35	-.07	.12	.36	-.23	.12
4.	.36	.45	.25	.21	.14	.08[b]	.40	.41	.09	.09	.21	.14
5.	.49	.28	.45	.28	.13	.14	.47	.33[b]	.11	.16	.44	.19
6.	.33	.09	.21	.17	.25	.19	.41	.36	.38	.18[b]	.28	.29
7.	.34	.05	.36	.26	.08	.25	.38	.50	.29	.36	.31	.30[b]
Total	.36	.20	.30	.22	.23	.11	.37	.14	.20	.06	.30	.08

Grade Nine

	Sub-tests											
	I		II		III		IV		V		VI	
Pro.	ETS-I	TMT	ETS-I	TMT	ETS-I	TMT	ETS-I	TMT	ETS-I	TMT	ETS-I	TMT
1.	.19	.19[b]	.29	.17	.26	.23	.14	.06	.36	.26	.30	.16
2.	.27	.24	.45	.25[b]	.29	.15	.20	.19	.28	.11	.32	.28
3.	.13	.42	.22	.36[b]	.25	-.05	.19	.59	.18	.30	.11	.41
4.	.21	.37	.39	.36	.28	.21[b]	.31	.23	.34	.39	.32	.17
5.	.41	.42	.25	.26	.59	.47	.44	.30[b]	.40	.21	.56	.46
6.	.29	.33	.33	.25	.20	.24	.20	.14	.47	.45[b]	.33	.23
7.	.22	.18	.47	.35	.32	.38	.34	.25	.36	.29	.26	.34[b]
Total	.28	.23	.31	.10	.33	.20	.28	.08	.42	.12	.30	.16

[a] The Standard Accelerated class (designated as program 3) which followed a 2nd year algebra rather than the geometry sequence in Grade 9 was treated as a separate program.

[b] Sub-test derived from the content of the particular program.

In grade eight the findings were about the same. Only for Standard Accelerated (both programs) was the highest correlation of the TMT with their "own" sub-test. In all other cases, end of year scores on the specific content taught, had lower correlations with the sub-test ostensibly drawn from that content than with sub-tests drawn from other content. For example, while the highest TMT-sub-test correlations at grade eight was .51 and occurred between sub-test II (Standard Accelerated) and the TMT for the Standard Accelerated program, a correlation of .50 was found for pupils in the UICSM-7 program between sub-test IV (SMSG-Accelerated) and the UICSM-7 TMT. One of the lowest correlations, .08, was found for the SMSG-Normal pupils between their "own" sub-test and their own TMT.

The situation changed little in grade nine. The content sampled from the specific courses of study for inclusion in the ETS-II sub-tests bore minimal relationship to the content included by the teachers in their end of year tests. Thus, the two sets of measures were really tapping relatively different content: Educational Testing Service selected what was considered crucial in what was to be taught; the teachers selected what they believed had been taught.

Inter correlations Among Achievement and Attitudes Variables Across Grades (Table 5-57).

Correlations between seventh grade total attitudes and later achievement were generally low, ranging from a high of .22 with the eighth grade TMT scores to a low of -.04 with sub-test V of the eighth grade ETS-II. However, all but five of the 26 correlations were significantly different from zero at the .05 level. Seventh grade self-appraisal of one's own mathematical ability (Category V of the Questionnaire on Mathematics) was somewhat more related to later achievement than were total attitudes toward mathematics.

Table 5-57

Intercorrelations of Achievement and Attitude Variables Across 7th, 8th and 9th Grades for All Pupils (N=813)[a] in Seven[b] Mathematics Programs.

Achievement Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1. ETS-I-7		.61	.35	.42	.35	.44	.38	.42	.59	.45	.24	.32	.24	.23	.34	.13	.27	.58	.50	.19	.24	.30	.30	.22	.40	.28	.15	.16	.02	.26	.12	∓02
2. ETS-II-7			.39	.70	.65	.68	.60	.66	59	.54	.20	.32	.30	.28	.40	.20	.32	.58	.52	.16	.25	.26	.29	.26	.50	.26	.12	.18	.08	.26	.10	.00
3. TMT-7				.25	.34	.32	.15	.20	.40	.30	.43	.22	.24	.11	.20	.12	.13	.38	.24	.32	.18	.04	.29	.06	.24	.07	.16	.20	∓02	.24	.05	∓09
4. ST-I-7					.34	.34	.29	.36	.42	.36	.10	.22	.17	.20	.26	.12	.22	.42	.38	.11	.15	.19	.19	.22	.37	.22	.08	.12	.09	.20	.10	∓02
5. ST-II-7						.30	.25	.26	.34	.32	.28	.28	.22	.18	.22	.08	.12	.38	.25	.12	.15	.07	.22	.10	.26	.06	.10	.16	.01	.21	.06	.00
6. ST-III-7							.26	.28	.42	.42	.16	.24	.23	.24	.29	.15	.26	.39	.32	.09	.17	.11	.25	.12	.36	.14	.06	.10	.06	.16	.06	.01
7. ST-IV-7								.30	.31	.32	.00	.14	.14	.12	.26	.14	.20	.30	.32	.08	.18	.18	.14	.13	.30	.17	.06	.08	.08	.14	.05	.00
8. ST-V-7									.44	.39	.04	.19	.18	.18	.30	.15	.26	.41	.46	.10	.17	.34	.16	.28	.36	.29	.08	.13	.03	.14	.07	.00
9. ETS-I-8										.53	.25	.36	.30	.23	.37	.20	.30	.60	.46	.20	.23	.36	.26	.26	.42	.30	.10	.19	.04	.28	.07	∓07
10. ETS-II-8											.23	.54	.40	.55	.66	.47	.64	.51	.52	.24	.34	.22	.32	.22	.45	.29	.10	.15	.05	.24	.08	∓06
11. TMT-8												.20	.22	.11	.14	.06	.03	.36	.09	.38	.11	.00	.25	∓02	.08	∓04	.22	.26	∓09	.35	.10	∓12
12. ST-I-8													.14	.20	.16	.10	.16	.34	.26	.15	.16	.12	.20	.10	.20	.17	.08	.13	.02	.17	.06	∓08
13. ST-II-8														.10	.14	.08	.12	.30	.29	.10	.15	.18	.20	.15	.16	.18	.08	.13	.00	.20	.06	∓02
14. ST-III-8															.24	11	20	.26	27	.12	.15	.12	.14	.08	.24	.16	.04	.08	.04	.11	.01	∓01
15. ST-IV-8																.16	.36	.38	.34	.16	.22	.12	.23	.14	.36	.14	.08	.10	.07	.12	.04	∓05
16. ST-V-8																	.14	.22	.26	.12	.20	.15	.10	.12	.18	.15	-04	.04	-02	.04	.04	.01
17. ST-VI-8																		.24	.32	.14	24	.09	.18	.14	.30	.18	.10	.05	.06	.16	.06	∓03
18. ETS-I-9																			55	.32	.28	.31	.33	.28	.42	.30	.20	.26	.06	.36	.10	∓01
19. ETS-II-9																				.25	.55	.60	.46	.59	60	.65	.14	18	.06	.32	.10	.00
20. TMT-9																					.23	.10	.20	.08	.12	.16	.16	.16	.02	.32	.10	∓06
21. ST-I-9																						.14	.20	.18	.28	.19	.10	.12	∓02	21	.05	∓06
22. ST-II-9																							.02	.38	.08	.44	.10	.16	.05	.26	.08	.00
23. ST-III-9																								.10	.30	.09	.10	.12	∓02	18	.08	∓06
24. ST-IV-9																									.16	.38	.02	.05	.04	.16	.04	.06
25. ST-V-9																										.20	.07	.08	.09	.12	.04	.03
26. ST-VI-9																											.08	.12	.04	20	.08	03
27. Tot. Att.-7																												.80	∓27	.42	.13	∓18
28. Cat-V-7																													∓33	.38	.14	∓26
29. S-A-7 [c]																														∓12	-02	42
30. Tot Att.-9																															.23	∓23
31. Cat-V-9																																∓10
32. S-A-9 [c]																																

[a] Longitudinal sub-test correlations were calculated only on those pupils for whom complete data across the 3 years were available.

[b] One Standard Accelerated Class (designated as program 3) followed a 2nd year algebra rather than the geometry sequence in Grade Nine and was created as a separate program.

[c] Negative correlations with the self-attitudes scale represent + relationships since the S-A scores were scaled from a high of 1 to a low of 5.

Twenty-five of the 26 correlations were significantly different from zero. However, the highest observed correlation was .26 with the eighth grade TMT scores and the ninth grade ETS-I scores, accounting for less than 7% of the variance of the two achievement measures.

The seventh grade ability self-ratings bore little relationship to any of the achievement variables. Only six of the 26 correlations were significantly different from zero at the .05 level, and none of these exceeded .09. In fact, only one of the significant correlations bore a positive relationship to achievement, and that was with TMT 8. The relationship of end of ninth grade attitude scores to achievement was somewhat higher than was true for the seventh grade. In fact, end of ninth grade attitudes had higher correlations with seventh and eighth grade achievement than did seventh grade attitudes toward mathematics. The average correlation of the total Questionnaire on Mathematics score with the 26 achievement variables was approximately .21. The highest correlations were with the eight grade Teacher Made Tests and all three of the ninth grade achievement measures, ranging from .32 to .36. All but one of the correlations was significantly different from zero at the .05 level.

Neither of the end of ninth grade self-assessment measures (Category V of the Questionnaire on Mathematics or the Abilities Self-Rating Scale) bore any meaningful relationship to achievement. Between Category V and the achievement variables, only half of the correlations were significantly different from zero and the largest of these was .12 (with seventh grade ETS-I scores) and the average was about .07. Of the 26 correlations between the Abilities Self-Rating Scale and the achievement variables, only four differed significantly from zero. The greatest was -.12 with the eighth grade TMT scores.

Although none of the achievement variables was meaningfully related to pupils' attitudes toward mathematics or toward their own mathematical ability or to their general self-assessment, the end of eighth grade Teacher Made Tests appeared to be most consistently related to attitudes scores, although the magnitude of the relationship was low.

The attitude measures themselves showed variable relationships to each other when correlated both with and across the two testing times. The highest correlation, .80, was between the total seventh grade Questionnaire on Mathematics score and the score on Category V of that test. However, in grade nine, the correlation between the total score and the Category V score was only .23, suggesting that a pupil's view of his own mathematical competence was less related to his general appraisal of the nature and significance of mathematics in grade nine than had been true in grade seven. The Abilities Self-Rating Scale correlated -.27 and -.33 with total score and Category V scores, respectively, in grade seven, and -.23 and -.10 with these two variables in grade nine. The correlations between grade seven and grade nine scores on each of the three attitude measures were .42 for the total Questionnaire on Mathematics and the Abilities Self-Rating Scale and .14 for Category V. The latter, which represented student self-appraisal of their mathematical competence, appear to be the least consistent measure of the three.

In general, the relationship between attitudes toward mathematics, including assessment of one's own mathematical ability, bore little relationship to achievement. One's general self-rating of abilities appeared to bear no relationship to achievement. These correlations support the findings of the analyses of covariance which demonstrated that the highest achieving programs had the least positive attitudes toward mathematics and the lowest appraisals of their abilities in general and their mathematics ability in particular.

Chapter VI

Summary, Conclusions and Implications

The TYP Mathematics Study emerged from an earlier project conducted in cooperation with the Junior High Schools of Cheltenham Township (Pennsylvania) Public Schools. The project assessed the effects of varied instructional procedures and content on the achievement and attitudes of four comparable classes of gifted junior high school students over a three-year period. The following tentative conclusions emerged from the study: (a) acceleration, either through standard or contemporary mathematics curricula, seemed to provide talented students with meaningful and enriching experiences and (b) enrichment seemed to become meaningful only when able students dealt with more advanced and more difficult concepts. The Cheltenham Study involved only four classes with a single teacher for each program, making it difficult to separate teacher effects from program effects. A grant from the United States Office of Education Cooperative Research Program for a demonstration-research project, together with continued support from the Horace Mann-Lincoln Institute of School Experimentation, made possible a comparison of varied approaches to mathematics for able junior high school students with a number of classes for each program.

Purpose of the Study

The purpose of the TYP Mathematics Study was to assess the relative effectiveness of varied approaches to the teaching of mathematics to academically talented junior high school pupils. The study was aimed at comparing the effects of standard, traditional mathematics programs with contemporary ones and of accelerated programs with enriched ones. Pupil achievement was defined in terms of (a) general ability to deal with quantitative relationships; (b) mastery of content of a particular mathematics program; and (c) ability to apply mathematics concepts and skills learned in one program to problems and processes derived from the content of other programs.

Hypotheses

The two hypotheses tested in this study were:

Hypothesis I -- Rapid sequential progress through a mathematics program is more effective than plans which provide either intermittent enrichment units (even when these are of an advanced nature) or depth study of normally paced sequential materials as measured by:

a. General mathematical competence;

b. Ability to apply knowledge to unfamiliar mathematical material;

c. Positive attitude toward mathematics.

Hypothesis II -- Compared with programs which follow a standard, traditional sequence, regardless of pace, programs which deal with contemporary mathematical content and methodology will result in:

a. Greater general mathematical competence;

b. More marked ability to apply knowledge to unfamiliar mathematical materials;

c. More positive attitudes toward mathematics.

Design of the Study

Population Selection.

Pupils were selected on the basis of general intelligence (IQ above 120) and sixth grade reading and arithmetic achievement (scores approximately one and a half to two years accelerated). Attitudes toward mathematics, self-rating of ability, socioeconomic status as well as interests, academic preferences, etc., were assessed but were not considered in pupil selection.

A total of 25 school systems, 51 classes and about 1500 pupils initially participated in the study. Complete, usable data at the end of the seventh grade were available for 1477 pupils. During the second year (eighth grade), 49 classes were involved with data available for 1271 pupils. By the end of the third year (ninth grade), due to normal attrition, changes in state requirements and overcrowded conditions in some schools, the number of classes dropped to 37 and the number of pupils, on whom all data were available for the three years, to 868. [a]

Program Selection.

In selecting programs for comparative study, six were chosen which were presumably differentiated according to content (standard or contemporary) and teaching-learning pace (enriched or accelerated).

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[a] Since only one of the Standard Accelerated classes followed a second-year algebra sequence in grade nine as originally agreed on, the 25 pupils of this class were not included in the sub-test or within program analyses.

Two standard or traditional programs were included, one enriched and the other accelerated. The remaining four programs were contemporary in nature, one enriched and the other three accelerated in various ways.

Standard referred to programs using mathematical content found in junior high school texts published prior to 1957, characterized by an emphasis on arithmetic processes and social applications in grade seven and eight and by an elementary algebra course in grade nine taught by the demonstrative method.

Contemporary referred to programs recently developed for the purpose of updating mathematical content. These are the programs usually referred to as "new" mathematics. Two contemporary programs were selected-- School Mathematics Study Group (SMSG) and University of Illinois Committee on School Mathematics (UICSM).

Enriched referred either to the addition of content outside the regular sequence of the standard text (as in the Standard Enriched classes where units were added each year) or to depth study of particular aspects of the standard sequence of a program (as in the SMSG-Normal classes).

Accelerated programs provided either for moving through a given sequence in less time than usual (e.g., completing seventh and eighth grade arithmetic in a single year and then going on to more advanced work as in the Standard and SMSG-Accelerated programs), or beginning a given sequence a year or two earlier than normal (e.g., starting the UICSM ninth grade program in grade seven or eight instead of in grade ning).

The six programs were designated as follows:

a. Standard Enriched -- These classes followed the sequence found in most commercial texts for seventh and eighth grade arithmetic and first-year algebra. In addition, special "enrichment" units, based on concepts more advanced than those included in the standard program, were presented. In grade seven, for example, pupils dealt with Mensuration and An Introduction to Mathematical Structure; in grade eight they were exposed to such content as Number Patterns and Probability; in grade nine, they learned about Sets and the Structure of Algebra, Linear Programing and the Theory of Games. Four special units were added in grade seven, four in grade eight and three in grade nine.

b. Standard Accelerated -- These classes completed the standard seventh and eighth grade materials in a single year and the standard first-year algebra course in the eighth grade. At this point, for a number of reasons, all but one of the classes which remained in the program, moved into a plane geometry course. Only a single class followed a second-year algebra course as originally intended.

c. SMSG-Normal -- These classes followed the Math for Junior High School, Volumes I and II, and the First Year Course in Algebra sequence at the pace intended by the SMSG authors. However, pupils engaged in an intensive study of the most critical topics.

d. SMSG-Accelerated -- These classes were accelerated through the SMSG materials, and covered a four year sequence in three years. In addition to the work covered by the SMSG-Normal classes, these accelerated classes also completed Intermediate Mathematics.

e. UICSM-8 -- During the seventh grade, these classes covered essentially the same materials as the SMSG-Accelerated groups. They then began the ninth year UICSM program a year earlier than normal. They completed Units I, II, III and part of IV by the end of grade eight, and the rest of IV and all of Unit V by the end of grade nine. This represented an algebraic sequence.

f. UICSM-7 -- These classes began the UICSM program two years earlier than usual, completing Units I, II and III by the end of grade seven, IV and V in grade eight, and VI (the year's work in geometry) in grade nine.

Teacher Training.

Teachers who participated in the study met in program groups for in-service training in the content and methodology appropriate to the course of study they were to follow. Special consultants were provided for each program and remained with the teachers for the three years. The number of in-service sessions varied from year to year and from program to program, depending upon the newness of the material to the teachers and their expressed requests for help.

Testing Program.

At the end of each of the three junior high school years (grades 7, 8 and 9), all pupils were tested on the appropriate form of the Developed Mathematical Abilities Test (ETS-I) and the Mathematics Achievement Test (ETS-II) developed by the Educational Testing Service expressly for this project. In addition, Teacher-Made Tests (TMT) were developed yearly by the teachers and consultants of each program and were intended to test the content covered by the particular program only. At the end of grade nine, all participating pupils were again given the Questionnaire on Mathematics and the Ability Self-Rating Scale.

Analyses of the Data.

To control for initial differences in pupil intelligence, reading and arithmetic achievement, attitudes toward math, socio-economic status and self-assessment of ability, a series of multiple regression analyses were performed on all test scores. The residual scores yielded by the regression analyses as well as the raw scores were subjected to analyses of variance. Total scores of ETS-I and ETS-II and the sub-test scores of ETS-II were analyzed both across and within programs each year. The TMT's were examined yearly, but only within each of the programs. The ninth grade scores on the attitudes measures were analyzed by covariance, using seventh grade scores as the covariate. For all measures, contrasts were performed (where appropriate) among individual programs as well as between two sets of program clusters: (1) standard vs. contemporary; (2) enriched vs. accelerated.

Summary: End of Grade Seven [a]

A total of 1477 pupils enrolled in 51 classes engaged in the six programs of the study. At the end of the first year, some consistent differences between programs were observed. On the raw scores of the Developed Mathematical Abilities Test (ETS-I), the Standard Enriched program fell significantly below each of the other programs. On the residual scores, they differed significantly only from the two SMSG programs. On the Mathematics Achievement Test (ETS-II) the SMSG-Accelerated and the UICSM-8 programs combined did significantly better than any of the others while the Standard Enriched fell below all others on both the raw and residual score analyses.

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[a] Since the UICSM-8 program was not to begin the ninth grade UICSM course until grade eight, the classes spent the seventh grade in a course of study similar to the SMSG-Accelerated program. The two programs were combined, therefore, for teacher in-service sessions, for the Teacher-Made Tests, for developing Sub-test IV of the seventh grade ETS-II Test; and for for some of the analyses.

On the sub-test analyses, the Standard Enriched ranked lowest on all but the UICSM-7 sub-test where it ranked fifth, while SMSG-Accelerated ranked first or second on all five sub-tests.

The various cluster comparisons favored the contemporary programs over the standard and the accelerated over the enriched. At the end of the first year of the study, the combined SMSG-Accelerated and UICSM-8 programs appeared most advantageous, the Standard Enriched least successful, at least on the basis of the measures used.

Summary: End of Grade Eight

At the end of two years' participation in the experimental programs, the trends noted at the end of the first year were largely confirmed, at least as measured by the instruments employed in this study. The only noteworthy changes were in the general improvement shown by the UICSM-7 program and the drop of the Standard Accelerated program, especially on the Mathematics Achievement Test (ETS-II). However, on the Teacher-Made Tests, teacher expectations were more closely approached in the two standard programs and UICSM-8 than they were in the SMSG or the UICSM-7 programs. The latter, which achieved the lowest TMT scores, nevertheless exceeded its predicted scores on both ETS measures while the two standard programs, with high TMT scores, achieved negative residual means on both ETS tests. In fact, the rank order correlations between class means on the TMT's and on each of the two ETS tests across the six programs were both negative.

However, the product moment correlations between ETS-I and the TMT's and between ETS-II and the TMT's for the total population were positive and significant (.36 and .31 respectively) indicating that within each program those pupils who scored higher on the ETS tests also scored higher on their Teacher-Made Test.

The analysis of the sub-test scores found that only one program, SMSG-Normal, exceeded all other programs on its own sub-test. However, only in the case of UICSM-8 did any program fail to achieve its highest mean score on its own sub-test. UICSM-8 appeared to be the program which enabled its students to cope most effectively with material not in their own course of study. Their mean residual score across the "other" sub-tests was the highest, exceeding their score on their "own" sub-test. Although each of the programs had positive residual means on their own sub-tests, only SMSG-Accelerated and the two UICSM programs had a positive residual mean score on the combined "other" sub-tests. The Standard programs and SMSG-Normal were, thus, less capable of handling material which they had not been taught directly than were SMSG-Accelerated and the two UICSM programs. The contrast between the enriched and accelerated program clusters (Standard Enriched plus SMSG-Normal vs. Standard Accelerated, SMSG-Accelerated, UICSM-8 and UICSM-7) yielded significant differences favoring the accelerated cluster on sub-tests II, IV, V and VI. The contrasts between the standard and the contemporary program clusters were significant only on sub-tests III, IV and VI. In each of the three, the contemporary exceeded the standard.

Classroom variability within programs continued to be significant. Of the 36 within program analyses of variance (raw and residual scores on three measures for each of six programs) all but three yielded significant F ratios. Only on the Developed Mathematical Abilities Test (ETS-I) residual scores were there no significant classroom differences in the Standard Enriched, the SMSG-Accelerated and the UICSM-8 programs. It would appear that when individual pupil differences were held relatively constant, the mathematical knowledge assessed by ETS-I was less influenced by teacher or group differences than was the competence assessed by the cross-program Mathematics Achievement Test or the Teacher-Made Test specific to each program.

On the whole, the three accelerated, contemporary programs exceeded the other three on almost all measures and appeared superior particularly in their general mathematical competence and in the ability to handle content to which they had not been directly exposed.

Summary: End of Grade Nine

Toward the end of the second year of the study, a number of school systems indicated either their inability to participate for the third year or to follow the agreed-on mathematics program (i.e., second course in algebra rather than a geometry course). Three districts which sent their pupils to the ninth grade of a regional high school were unable to maintain their classes intact due to overcrowded conditions and double sessions which created programming problems. In one or two instances, schools simply announced their withdrawal on the basis of internal problems. Most of the New York State classes in the Standard Accelerated program insisted on moving their ninth grade pupils into geometry instead of the second-year algebra, as originally planned. Only one Standard Accelerated class remained with the original algebra sequence.

Thus, the third year of the study began with 38 classes (out of the 49 classes which had completed grade eight). However, at the end of the year, it appeared that one of the UICSM-8 classes had followed a different sequence from the one set for that program as a whole, and was, therefore, eliminated from all ninth-year achievement analyses but retained for the attitude assessments. The single Standard Accelerated algebra class was treated as a separate program for the cross-program analyses (except for the ETS-II sub-tests) but excluded from the within-program analyses.

At the end of grade nine, all participating pupils were tested on new forms of the Developed Mathematical Abilities Test (ETS-I), the Mathematics Achievement Test (ETS-II) and on a Teacher-Made Test (TMT). The Questionnaire on Mathematics and the Ability Self-Rating Inventory which had been administered at the beginning of grade seven were re-administered at the end of grade nine.

On both cross-program measures (ETS-I and ETS-II), when raw scores were considered, the contemporary program cluster exceeded the standard; the accelerated exceeded the enriched. When the scores were regressed to control for some of the individual pupil differences, both cluster contrasts remained significant on ETS-II, but the accelerated-enriched contrast on ETS-I no longer held up. On ETS-I, SMSG-Accelerated held first place and differed significantly from all but Standard Accelerated-algebra on both raw and residual score analyses and from all but UICSM-8 when the residual scores were considered. Either Standard Enriched or Standard Accelerated-geometry held the lowest positions.

On ETS-II, (on both raw and residual scores) the UICSM-7 program held first place and differed significantly from all other programs. SMSG-Accelerated scored significantly higher than all but UICSM-7. Standard Enriched held the lowest position with Standard Accelerated-algebra one from the bottom.

On the basis of the two cross-program achievement measures, the pupils in the SMSG-Accelerated program did best, even when differences in pupil abilities and attitudes were, in large measure, controlled.

Assessment of the raw scores on the various sub-tests found that while in some programs the students achieved their highest score and exceeded all other programs on their "own" sub-test; in other cases, students scored higher on sub-tests derived from other programs than they did on their "own". In several instances, the highest mean score on a sub-test was achieved by a program other than the one for whom the sub-test was intended. In general, Standard Enriched did least well of all the programs, scoring either last or next to last on all sub-tests; SMSG-Accelerated and UICSM-7 scored either first or second on all sub-tests.

On the sub-tests derived from the content of the accelerated programs, the accelerated cluster exceeded the enriched; on the SMSG-Normal sub-test, the enriched exceeded the accelerated. On the Standard Enriched sub-test, there were no significant differences due to pace.

The contemporary-standard cluster compariosns found the former significantly higher on five of the sub-tests. Only on the sub-test derived from the Standard Accelerated-Geometry program were there no significant differences due to approach.

When scores were controlled for initial differences in pupil abilities and attitudes, the analyses tended to point up the differences in performance between the programs which studied algebra and those which studied geometry. For example, SMSG-Accelerated, which dealt with advanced gebraic material fell below expectation on the two sub-tests derived from geometry content; while Standard Accelerated, which dealt with geometry, exceeded expectation on those two sub-tests. UICSM-7 retained its high standing and exceeded the other programs in 16 of the 20 significant contrasts in which it figured. Standard Enriched, which figured in 13 significant contrasts, fell below the comparison programs in 12 of them. The accelerated-enriched cluster contrasts remained as in the raw score analyses; contrasts between the contemporary and standard clusters yielded significant differences only on the three sub-tests derived from the contemporary, accelerated programs. All significant contrasts favored the contemporary cluster.

To the extent that the sub-test scores were indicative of the pupils' ability to cope effectively with material to which they had not been directly exposed, as well as with a small sample of the content derived from their own program, the several programs yielded quite disparate results. UICSM-7 pupils were most apt to exceed all others not only in responding to their own content but also to the content representative of other programs; Standard Enriched appeared least capable of dealing either with its own or with the content from other programs. The procedures through which the UICSM-7 pupils learned their own material seemed most apt to help them attack other problems successfully. These procedures included not only the methodology built into the UICSM approach to teaching contemporary mathematics, but also the fact that the pupils were at least two years accelerated and thus exposed to more varied and more advanced content than was true for the UICSM-8 pupils, who followed the same methodology but, because they were only one year accelerated, were exposed to less and less varied content.

At the end of grade nine, the analyses of ETS-I, ETS-II and TMT scores by classes within programs showed considerably fewer significant differences than had been observed in the first two years.

In fact, even where raw score analyses by classes within programs yielded significant F ratios, analyses of residual scores failed to reach a significant level. These findings suggested that, at the end of ninth grade, most of the observed differences among classes in any one program were more nearly a function of pupil ability than of teacher or intra-class factors not controlled in this study. These latter factors appeared to have less effect on class achievement at the end of grade nine, (especially on classes in the contemporary programs), than they had appeared to exercise in the earlier grades. One could speculate that ninth grade teachers, whether in the junior high school or in the senior high school (to which some ninth grade classes moved) are more uniformly competent in mathematics teaching than may be true of seventh and eighth grade teachers.

The relationships between class means on the two ETS measures varied considerably from porgram to program. It was highest for SMSG-Accelerated and Standard Accelerated, lowest for Standard Enriched. SMSG-Normal classes performed relatively comparably on the two tests when raw scores were considered, but showed a negative relationship when individual pupil differences were partially controlled. The relationship between class standing on the TMT's and ETS-II, both achievement measures, was equally variable from program to program. When mean residual scores were compared, rank order correlations ranged from a high of .80 for SMSG-Accelerated to a low of -.10 for SMSG-Normal.

Both the attitude measure and the self-rating scale administered at the beginning of grade seven were readministered at the end of grade nine. To control for initial differences in attitudes and self-ratings, analyses of co-variance were performed on the ninth grade scores adjusted by seventh grade scores. In general, the results went contrary to expectation. The pupils in the contemporary programs expressed less positive attitudes toward mathematics and mathematicians than did pupils in the traditional, standard programs. Teaching-learning pace had no effect on attitudes. On the

Abilities Self-Rating Scale, neither of the cluster contrasts reached significance although there was a significant difference among programs. In general, one's appraisal of the nature or significance of mathematics or of the characteristics of mathematicians, or even one's own assessment of mathematical ability had no significant effects on achievement. In fact, by the end of grade nine, those programs which achieved least well showed the most positive attitudes.

Longitudinal Analyses

To assess the cumulative effects of the several programs over the three-year period, all pupils were rank-ordered on residual ETS-I and ETS-II scores, separately for each of the three years. The three yearly ranks for each test separately and for both tests combined were then summed for each student and cross program analyses of the rank "scores" were performed. All three rank comparisons (ETS-I, ETS-II, both tests combined) yielded significant Chi Squares. In all three cases, the contemporary cluster exceeded the standard and the accelerated ranked higher than the enriched. On ETS-I, SMSG-Accelerated ranked first; UICSM-8, second; and SMSG-Normal, third. Standard Enriched ranked lowest, exceeded somewhat by Standard Accelerated. UICSM-7 fell at about the middle.

On ETS-II, SMSG-Accelerated again ranked first and the two-year accelerated UICSM-7 held second place, followed by UICSM-8 and SMSG-Normal. The two standard programs were in the two lowest places, with Standard Enriched below Standard Accelerated.

On the two tests combined, The three contemporary accelerated programs (SMSG-Accelerated and both UICSM's) ranked significantly higher than

Standard Enriched. SMSG-Accelerated, which ranked highest, also exceeded Standard Accelerated. For the three years and on the basis of the two ETS tests, with individual pupil differences in ability and attitudes at least partially controlled, the SMSG-Accelerated program ranked highest, followed by UICSM-8 and UICSM-7 in that order. SMSG-Normal ranked fourth; Standard Accelerated, fifth; and Standard Enriched was at the bottom.

Conclusions and Discussion

The results of the study only partially supported the two hypotheses. In most of the analyses of cross-program scores, the four accelerated programs exceeded the two enriched ones and the four contemporary programs exceeded the two standard, traditional ones. However, while the contemporary programs resulted in "greater gain in general mathematical competence" and in the "ability to apply knowledge to unfamiliar mathematical material," they failed to generate "more positive attitudes toward mathematics," in general, or to raise the pupils' assessment of their own mathematical ability above the level of the standard programs.

The accelerated programs generally exceeded the enriched ones on both mathematical competence and application of knowledge to new materials. However, these results were due to the higher scores of the three contemporary accelerated programs which outweighed the single standard accelerated one. Within the standard approach, the accelerated classes generally exceeded the enriched ones. Here, as for the hypothesis relating to the contemporary-standard comparisons, the accelerated classes failed to demonstrate more positive attitudes toward mathematics than those in the enriched programs.

In general, the study concluded that academically able junior high school pupils achieved a higher degree of general mathematical competence and showed greater ability to cope with relatively unfamiliar material in contemporary-accelerated programs than in contemporary-enriched, standard-accelerated or standard-enriched. Of all the program adaptations, the latter (standard-enriched) appeared to be the least successful on both achievement counts, but among the highest on the attitudes and self-rating measures.

Since over the three years, the three contemporary-accelerated programs proved about equally effective, it is not possible to compare the relative advantages of the two kinds of acceleration: beginning a sequence earlier than normal or working through a sequence more rapidly than normal. In both instances pupils are exposed to more varied and more advanced content than would otherwise be the case and are, thus, in a position to apply more extensive knowledge to the solution of unfamiliar problems. Nor can any conclusions be drawn regarding the relative merits of the SMSG and the UICSM programs when these are presented at an accelerated pace. In both programs the content and the methodology appear to have been more effective in fostering general mathematical ability and in enabling students to cope with relatively unfamiliar material than was true for the standard, traditional programs. Thus, contemporary-accelerated programs appeared to produce the best results, in terms of mathematical achievement, even though such programs apparently did not promote more positive attitudes toward mathematics.

Discussion of Results

Although acceleration resulted in greater achievement than enrichment, and the contemporary approach appeared superior to the standard one, it was in the combination of acceleration and contemporary content and methodology that the greatest learning occurred, at least in terms of the criteria set in this study.

Effects of Acceleration-- The accelerated pace, whether through rapid progress or earlier beginning, allowed for more extensive coverage of material than could occur under a normal pace. And it appeared that pupils exposed to more, and more varied knowledge, learned more and retained more. The accelerated students not only achieved a creditable degree of mastery over what would generally be taught in a normally paced sequence, but also had the advantage of being exposed to additional, more advanced subject matter. As a result of mastering a wider array of concepts and processes they apparently had a greater repertoire from which to draw in attacking relatively unfamiliar mathematical material. For instance, the UICSM-7 classes, which were accelerated an extra year over the UICSM-8 classes, covered plane geometry as well as algebra in the time that the UICSM-8 classes covered only algebra. Although the UICSM-7 program did not do as well as UICSM-8 on general mathematical competence as measured by the Developed Mathematical Abilities Test, they made the best showing on the various sub-tests of the Mathematics Achievement Test. On almost all measures, the accelerated SMSG program surpassed the performance of the normal-paced SMSG program. Only on the sub-test derived from the SMSG-Normal content did the normal paced pupils surpass the accelerants. In the standard programs, the Standard Accelerated pupils almost invariably scored higher than those in the Standard Enriched program.

Thus, in each case, acceleration gave bright pupils an advantage over those who followed a slower pace, even though the normal-paced programs were enriched by the addition of special units or by more intensive study of selected portions of the course of study.

The very fact that this sample of able junior high school students--seventh, eighth and ninth graders--performed as well as they did on the <u>Developed Mathematical Abilities Test</u> which consisted of items drawn from the Scholastic Aptitude Test pool, intended for eleventh and twelfth grade students, has important implications for program planning. Some students in almost all programs achieved perfect or near perfect scores and, in most classes, students solved, on the average, about 70% of the problems correctly. This fact supports findings from other studies (e.g., those of Project TALENT) which discovered that bright youngsters at lower grade levels achieve as well or better than less bright or "less taught" students at higher grade levels. Such data reinforce the belief that able youngsters can be taught more and more advanced content at earlier ages than curriculum developers often consider possible or desirable.

This study further helps to allay some of the fears of those who contend that an accelerated pace will lead to superficiality and that pupils will lack the depth of understanding which would result from "horizontal enrichment." At least in the study of mathematics, it appears that a pace which enables bright students to deal with more advanced content earlier does not preclude adequate mastery of basic concepts and processes needed to proceed to the more advanced work.

<u>Effects of the Contemporary Programs</u>-- The advantage of the contemporary over the standard programs may be attributed, in part, to the methodology of

the former, which placed more responsibility upon the pupils to "discover" solutions and arrive at generalizations. In part, the advantage may also have resulted from the greater emphasis on abstract manipulations and structural aspects of the material which may have provided the students with greater flexibility in dealing with relatively abstract quantitative relationships than was achieved by the more content bound and applied nature of the standard programs. These advantages were not only marked on the relatively abstract problems of the Developed Mathematical Abilities Test, they also enhanced the students' ability to handle the applied problems in the sub-tests derived from the standard content.

Thus, the combination of covering more and more advanced content, on the one hand, and learning through a methodology which stressed "discovery" and content which dealt with abstract principles and structural aspects, on the other, provided students with a large repertoire from which to draw as well as a flexibility of approach through which to utilize their knowledge in the solution of unfamiliar problems.

It is especially interesting to speculate on the causes of the consistently poor performance of the Standard Enriched program. While the emphasis in the normal sequence was on problems which have "social utility" and on the use of text-book models or pre-taught algorithms in the solution of problems, these pupils were, nevertheless exposed to some "enrichment" units derived from the concepts and content of contemporary mathematics, similar to those found in the SMSG and UICSM programs. In addition, the special units dealt with content generally reserved for later grades and were, thus, accelerated in nature.

Why, then, did the Standard Enriched pupils fail to apply these learnings to the test questions, their "own" as well as those based on the contemporary programs?

The explanation probably lies, in large measure, in the discontinuity between the enrichment material and the standard course of study. Although the Standard Enriched pupils were exposed to a variety of "new" and relatively advanced concepts, these never became an integral part of their work and neither grew out of what preceeded nor led on to the next phase of a sequential, ordered program. Thus, the enrichment units remained encapsulated, independent of the main instructional sequence.

To the extent that the approach followed by the Standard Enriched program fairly exemplifies the concept of enrichment "by addition" the results of this study cast serious doubts on the effectiveness of such an approach.

School and Teacher Factors

However, factors other than the nature of the content and methodology may have influenced the differential performance of pupils in the several programs. Although differences in initial pupil ability and attitudes toward mathematics were largely controlled through regression, there was no way of controlling for differences in structure and climate of the participating schools or for the degree to which various school related factors affected performance. Each school and, in most instances, each school district was engaged in only one of the six programs. It was, therefore, not possible to determine the extent to which such factors as size and nature of the community (schools were located in large urban, small city, suburban and even semi-rural areas), differences in school organization (some were three year junior high schools, some were six year secondary schools, still others were two year junior highs and pupils moved to regional senior high schools for the ninth grade) and variations in local interest and support for the study, as well as the degree of teacher involvement and the adequacy and intensity of supervision affected the relative success of each of the programs. Although all participating teachers had relatively equal exposure to the in-service training provided by the project, the amount of help and support which they may have received in their own schools could have varied considerably.

Teacher factors such as amount of mathematical preparation, degrees earned and experience in teaching math were found to bear a significant relationship to pupil success at the end of seventh grade. In aggregate, such factors accounted for about 20% of the variance in pupil achievement. Thus, some of the differences attributed to programs may have resulted from differences in teacher preparation and teaching ability in the various school districts.

However, at the end of ninth grade, teacher factors appeared to be exerting less influence on pupil achievement than in the earlier grades. When initial pupil differences were controlled, most of the observed class differences within programs were no longer significant. It may be that ninth grade teachers tend to be more homogeneous with respect to subject matter preparation and competence than is true of teachers in the first two junior high school grades.

<u>Attitudes and Self-Appraisal</u>--Why the students who showed the greatest gains in achievement did not also show more positive attitudes toward mathematics is a question which cannot be answered from the data. The two UICSM programs scored lowest on the attitude measures in both grade seven and in grade nine; the standard programs scored relatively high at both points. In fact, the sample as a whole exhibited relatively little change

in attitudes over the three-year period so that the differences which were observed at the beginning of the seventh grade among the various programs were pretty much tose observed at the end of ninth grade. Neither the nature of the mathematics programs nor the achievement level of the pupils in any program seemed to affect attitude change either in terms of self appraisal of abilities or the assessment of the nature and importance of mathematics or their interest in its career possibilities. The expectation that success in mathematics would enhance pupil attitudes toward the field in general, and their engagement in it, in particular, was not realized. While pupils generally knew that they were involved in a study of some kind, they received no special feed-back regarding their achievement other than their scores on the Teacher-Made Test which was, in some cases, used by the teachers as a final examination. The ETS-I and ETS-II scores were not made available to teachers (and were thus unavailable to students) until the following fall, since they were machine scored over the summer. Perhaps more frequent and specific feed-back on achievement might have increased the relationship between expressed attitudes and achievement. A follow-up of these youngsters would help ascertain whether some programs had motivated greater student involvement with mathematics than others, determining how many students in each program take elective math in high school, how many go on to do more advanced mathematics or mathematics-related work in college, or, how many select careers which require extensive mathematical knowledge.

Cross-Content Comparisons. The classic "methods studies", characteristic of much of educational research, generally compared the relative effectiveness of two or more ways of teaching a common body of knowledge or a specific set of skills. In such studies the criterion measures could be based on the common content and differences in achievement could be, roughly, attributed to differences in method. This study confronted quite a different problem: what kinds of measures could be devised to assess the relative effectiveness of several courses of study which differed in content as well as in pace and in method. To answer this question required a definition of "effectiveness" not in terms of the mastery of a specific body of content but rather in terms of some basic abilities which cut across content and could, presumably be developed through various content combinations. Two criteria were set for this study: 1) The general ability to handle quantitative relationships which do not depend upon the knowledge of specific mathematical content beyond simple algebra; 2) the ability to apply concepts and processes learned in the context of one body of content to the solution of problems derived from a different body of content.

The two tests developed by the Educational Testing Service for this study were intended to measure the two criterion abilities. The <u>Developed Mathematical Abilities Test</u> (<u>ETS-I</u>) included items which were minimally bound by content derived from specific courses of study. For each year, the test items selected required little specific knowledge beyond what is commonly taught at that grade level. In the seventh grade <u>ETS-I</u> test, for example, where letter symbols or geometric figures were used, the processes by which they were to be manipulated depended on little more than general arithmetic competence. One need not have studied either algebra or plane geometry to have been able to solve the problem. In the ninth grade, some simple algebraic problems were included, negative and positive numbers were involved as well as simple linear graphing. In general, the <u>ETS-I</u> forms were minimally related to any specific content or vocabulary; nor did one have to have studied material beyond grade level to acquire the necessary competence for solving the problems.

The Mathematics Achievement Test (ETS-II) addressed itself to the measurement of the ability to apply concepts and processes to relatively unfamiliar content. To accomplish this purpose, the test was composed of a number of sub-tests equal to the number of programs involved. For each sub-test, a series of items was drawn to represent each of the programs and all the pupils were asked to tackle all the problems - their "own" as well as those derived from "other" programs. To arrive at the six to eight items for each sub-test, the total course of study of a given program was reviewed each year and those mathematical ideas and processes which were considered most basic or occurred most frequently were included. Where a program used a specific vocabulary, probably unfamiliar to pupils in other programs, "translations" were made or standard English forms substituted.

Had each of the courses of study been completely unique, without any overlap of content, the sub-tests could have provided valid information on pupils' ability to apply knowledge to really unfamiliar material. However, this was not the case in this study. For example, the enrichment units of the Standard Enriched program dealt with "contemporary" concepts which differed little from those taught in the sequential SMSG or UICSM programs. Or, the UICSM Plane Geometry (Book VI) generally covers much of the same material as a standard Plane Geometry course. Thus, the degree of unfamiliarity of the content varied from sub-test to sub-test and from year to year for pupils in the several programs. The degree of variation can be seen from the varying magnitudes of the sub-test intercorrelations over the three years.

In general, however, the sub-tests were relatively independent at each grade level and none of the correlations explained more than 25% (per cent) of the variance. Furthermore, some highly consistent patterns emerged, suggesting that, to the degree to which sub-tests represented unfamiliar content, pupils in the contemporary accelerated programs were consistently more successful in dealing with such content than were pupils in the other programs.

It might appear that the superior performance of the contemporary program students on the cross-program tests was a function of the greater number of items derived from contemporary content (There were four contemporary and only two standard programs). However, the intercorrelational matrices indicate no higher correlations among the contemporary sub-tests than between some of the contemporary and standard sub-tests. In fact, the highest correlation in the ninth grade ETS-II sub-test matrix was between the two "geometry" sub-tests-- one of which was contemporary (UICSM-7) and the other standard (Standard Accelerated).

The concepts underlying the two measures used in this study seem promising for cross-content comparisons in other subject fields provided that agreement can be reached on the common objectives of the varied courses and that the application of concepts and processes to new or unfamiliar content is considered a first order outcome of the learning process.

However, if such outcomes are to be assessed with confidence, the instruments need to be carefully pre-tested and modified to achieve a high degree of reliability. The instruments used in this study were developed for experimental purposes and time and resources were insufficient to refine them to a level which would be necessary for educational assessment. The reliabilities of both ETS tests were relatively low, for achievement measures. Despite original pre-testing of the materials, some of the items remained too difficult, others, too easy. Since no test-retest procedures could be followed, it was not possible to assess the reliabilities of the various sub-tests.

Problems of Longitudinal Field Research

This study provides a good example of the problems which confront the researcher in conducting field research, especially of a longitudinal nature. The major problem for the researcher is the maintenance of a sufficient sample in each treatment over a period of time. Schools, even when they are interested in the research and closely identified with the project, still must give first priority to the normal problems of everyday living-- they are beset by the changing complex of community pressures, by demands for participating in or abandoning "new" curricula, by bond issues passed or rejected, by pupil and staff mobility, and by a host of other factors which directly or indirectly influence participation in a long-term research study. Even with the best of intentions, some schools which initially participated, found that they were unable to stay in the study, despite their initial commitments. When practical problems cause a school to withdraw or modify its commitments, there is, of course, little that the researcher can do. If longitudinal studies of class performance are to result in significant findings which can be of value to schools, the initial samples must be far in excess of what will be required at the end. In this study, about 40% of the initial population was lost by the end of grade nine. About 15% of this loss was due to normal pupil mobility which tended to be relatively comparable across the various programs. But the greatest loss occurred at the end of grade eight when some 12 classes were withdrawn from the study, depleting some of the programs to such an extent that they no longer included the five classes set as a minimum.

Finally, there is the problem of doing a "timely" study in a period when there is great change underway in a particular curriculum area. School systems most likely to participate in a study of this kind in the first place would normally tend to be in the forefront of innovation. Such districts are also likely to be under considerable community pressure to move toward newer programs and procedures. The consequence is that some districts are not willing to wait for findings from longitudinal studies. If a neighboring community has initiated a modern mathematics program, it is difficult for a school district to delay such innovation until the findings of a longitudinal study are all in. The general tendency is to respond to pressures for innovation and justify such action on bases other than valid research findings.

In a sense, this demonstration-research project was outdated when it began. The pressures for new mathematics curricula had begun to build in the mid-1950's so that there was little doubt that schools would move in the direction of contemporary programs by the early 1960's. In a way, it is fortunate that the findings from this study support contemporary mathematics curricula, accelerated for bright pupils. In the climate of the times, it is questionable whether findings to the contrary would have much effect on stemming the tide of change underway in school mathematics programs.

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